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ELECTRICAL WORLD AND ENGINEER.

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HONEST WORK.

It is with deep regret that we record this week the death of Luther Stieringer, for many years past one of the most interesting men connected with the development of electric lighting, and one who has in many ways left a deep impress upon the early practical stages of the art. It is very much to the credit of Mr. Stieringer's courage and foresight that at the very beginning of electric lighting, although then highly successful in the field of gas lighting, he recognized the importance of the new illuminant and extended to it a warm welcome rather than opposing it as so many prominent gas engineers did. He not only gave his earnest support to Mr. Edison and others, but himself was instrumental in effecting some of the most valuable improvements in fixtures and details that were necessary to render electric lighting by the incandescent lamp possible and successful. In addition to this, while lending his energies to promote the merely commercial development of the art, Mr. Stieringer was one of the first to realize and seize upon the superior plasticity of the new illuminant as an element in decorative lighting, and some of the most brilliant and memorable work in the field of spectacular effects, especially at exhibitions, was due to his skill and good taste.

Over and above all, the quality that must be most commended in the work of this pioneer is his energetic insistence upon the necessity of honest work. He fought tooth and nail against everything which pointed in the direction of defective insulation and danger to life or property; and while this sentiment carried him sometimes to extremes and blinded him to the real value of great advances, as, for example, alternating-current development, it enabled him to do a great deal that was permanently valuable in perfecting the modern system of incandescent illumination. Possibly had Mr. Stieringer been a man of less violent likes and dislikes, and more politic and considerate in his dealings with some of his fellow men, he might have gone further as a champion of that which is best and permanent in the art; but after all is said and done, his influence was always for good, and his departure from among us deserves more than ordinary recognition. It was, we are glad to know, a matter of pleasure to him as he passed away that in addition to many of the other medals and awards conferred upon him for his work in illumination, he had just been granted one of the medals of the Franklin Institute specifically for his improvements in the field of electric lighting.

THE STREET RAILWAY INDUSTRY.

In our recent issues considerable space has been given to the interesting and valuable data presented in the recent bulletin issued by the United States Census Office on the statistics of the street railway industry of the United States. The totals which are presented in this report are truly imposing, revealing tremendous advances in the last ten years, with consequent benefit to the public without a single drawback worthy of the slightest consideration. It is interesting to note that the total capital obligations of the industry represented at the time the figures were compiled last year, a total of not less than $2,300,000,000, with 22,589 miles of track and over 60,000 passenger cars. One of the most interesting figures which emerges is that of earnings, the companies showing gross receipts from operation of $247,553,000, of which all but $14,000,000 was received from passengers. The total receipts from passenger earnings of the steam railroads of the country for the same annual period were only $393,-

000,000. Upon the basis of the population of 1900, the average number of street car rides per inhabitant was 63 in 1902, or just double what it was in 1890. It appears upon this basis and upon the figures of earnings, that the average expenditure per head in the United States for street railway service is just about $3, and that the enormous number of 4,809,554,438 fare passengers were carried in 1902.

It is needless to say that this enormous expansion of traffic and utility is wholly due to the introduction of electricity. It is also interesting to note that the system for the 797 companies reporting the figures, out of 817, showed 133,641 wage earners, whose income amounted to $80,000,000. It is altogether inconceivable that but for the aid of electricity the street railway system of the country would have been able to give employment to so many men of a higher grade, and under better conditions, than those who once drove horse cars. Equally interesting are the figures which we have quoted with regard to motive power, car equipment, etc., showing a total power house capacity of 1,204,238 horse-power of dynamos, and a daily kilowatt-hour output of 6,249,910, representing roughly a total operation of about five hours daily of all the apparatus reported. And yet great as these figures are, it is evident to the most casual observer that ten years hence the statistics are likely to show as great an increase as those of 1902 have shown over those of 1890 in the application of electricity to the transportation of the traveling public in cities, as well as outside city limits.

ENGINEERING ENGLISH.

A paper on this subject was read by Mr. T. J. Johnston at the Niagara Falls convention of the American Institute of Electrical Engineers, which criticises the English of many engineers. As some facetious gentleman has remarked on the same subject: "Much engineering English is Dutch." The criticism is no doubt valid to a large extent. Engineers often write inelegant English, and sometimes write incorrect English. It is desirable that their attention should be called to a fact, which, however patent to senses cultivated in this direction, is often completely concealed from the subjects. A man who may speak and write very defectively in English, often fondly imagines himself to be quite superior to criticism in such matters. The only hope for improvement lies in free criticism, and in requiring that students in engineering shall pass adequate examinations in English prose composition. On the other hand, however, more excuse exists for imperfections in the language of those who express themselves in deeds rather than in words, on metals rather than on paper. It is undoubtedly desirable that an engineer's English should be good, but of yet greater importance is clearness and lucidity of statement.

LIGHTNING PROTECTION.

Of the several discussions at the Niagara Institute meeting, the most notable and by far the most extensive, was that on the group of high-tension transmission papers—or more correctly, on the introductions prepared by specialists with a view to exciting discussion on the several topics thus brought before the meeting. Much credit for this successful issue is due to Mr. Ralph D. Mershon, to whom the preparation of this part of the programme was confided, and who at the sessions was indefatigable in prompting thorough discussion. The discussion on these topics alone would fill a small duodecimo volume, and owing to the lack of precise statement natural in extemporaneous speech, as well as much repetition by different speakers, its value when published in the transactions would be much enhanced by a most liberal use of the blue pencil on the part of the Editing Committee—a hint which moreover applies to Institute discussions in general.

The remarks on Mr. Mershon's paper on lightning protection brought into prominence the very great need of a thorough study of this most important problem. The data are at present so ragged that it is quite impossible to draw valid conclusions from them. Even in so simple a matter as the advantage derived from a grounded guard wire, engineers of experience seem unable to reach any consensus of opinion. Lightning is one of the comparatively few things which cannot be made the subject of experimental study on an adequate scale, so that the somewhat meager information that is gathered comes to us in unrelated scraps. Hence it is particularly hard to generalize upon the subject. This much, however, seems certain, that in protecting a long line, four classes of disturbances must be dealt with: direct strokes, electrodynamic induction, electrostatic induction, and finally atmospheric charges independent of thunderstorms as such. As to the first mentioned, it is happily rare, and by common consent cannot be successfully dealt with by means of guard wires, or certainly even by the most cunningly contrived lightning arresters. Discharges of this sort generally show localized effects upon the line and are also accompanied by very violent phenomena at other points on the system. Because a line is struck, it does not follow that service will be interrupted, for the discharge sometimes passes to ground via the poles without even damaging the insulators, but the effects in the station may be disastrous. A good bank of lightning arresters will often prevent serious damage even under these conditions, but cannot be implicitly relied on.

To the second and third classes belong probably nineteen cases out of twenty of so-called lightning. What part of the general result must be charged to electrodynamic and what to electrostatic induction it is almost impossible to tell. We are inclined to think, with Mr. Thomas, that the electrodynamic action may often be a very serious factor in the total result. The energy represented in a lightning discharge of the first rank corresponds to a prodigious rate of output, and the primary voltage, if one may so call it, is counted in millions of volts. A horizontal flash between clouds may readily reach a mile or so in length and the electrodynamic effect on a line in the vicinity is necessarily something terrific. The electrostatic stresses are of corresponding magnitude, and the total result is adequate to almost any mischief. One feature of the case which is often forgotten is the immense size of the bodies which take part. We have a huge cloud perhaps half a mile in air and several miles broad, acting as one terminal of the condenser. Compared with these dimensions, the lines concerned are at the general level of the earth's surface and we have grave doubts as to the adequacy of the ordinary considerations in figuring out the effect of guard wires a few feet nearer or further from the earth. That their position above or below the line has little influence on their efficacy, we are quite prepared to believe, and we are also disposed to think that as regards both electrostatic and electrodynamic actions on a serious scale, they are of very limited value. It is all very well to theorize on shielding, but we may remind our readers that in the summer of 1898 two submarine mines near Ft. Monroe were exploded by inductive effects of the same thunderstorm, each being in a different group and on a different cable.

As to "static" in the common use of the term, the guard wire is at least of some service. Charges due to shifting potential of the air accumulate as a rule rather gradually and seldom represent any large amount of energy. They are common enough as we all know, and the potentials are often reckoned in thousands of volts. Disconnected lines are usually thus loaded, and we have no doubt that "static" often makes the proper adjustment of spark-gap arresters very troublesome and causes other unpleasant phenomena, but the

term is very loosely used and covers everything from resonance to surface leakage due to dirt. There is little doubt that a guard wire near the main line tends to reduce these atmospheric, and we might almost say, normal charges, very considerably. Where the difference in the height of various parts of the line is considerable, static effects may be of unusual magnitude and a guard line should be fairly effective as an equalizer. But lightning on a big scale is a very much more troublesome customer. Nevertheless we hope that "static" properly so called will receive serious attention from engineers. It is certainly true that on transmission lines there may usually be found symptoms, some very grave ones, of potentials greatly in excess of those pertaining to the normal operation of the system. It is of really great importance to locate the cause of these rises of potentials, so that one may know how they should be treated. If they are purely static, they require one treatment, if resonant quite another. Nothing but careful and persistent recording of the phenomena, and cautious experimenting wherever it is possible, will give us the facts regarding abnormal violent causes. The action of the Transmission Committee in making a determined effort to gather data is the best possible step toward a knowledge of the real facts of the case.

THE STORAGE BATTERY IN SUB-STATIONS.

An interesting paper on this subject was read by Messrs. W. E. Goldsborough and P. E. Fansler at the recent Niagara Falls convention of the American Institute of Electrical Engineers. It deals with tests made on the storage battery system of the Union Traction Company of Indiana. This company has a power house at the central point of Anderson, and transmits power along the lines of track to a maximum distance of 34 miles, employing eight sub-stations and a total track length of 160 miles. The average working load at the central station was about 2,000 kw, and the total storage battery power installed, about 250 kw, on the basis of a four-hour discharge. These batteries are installed at the sub-stations in connection with converters.

A new term is employed in the paper, viz.: the "efficiency of equalization" of the storage batteries. It is virtually defined as the ratio of the abnormal input to the abnormal output of energy. If the storage battery at any sub-station performed its functions perfectly, the power input from the high-pressure line to the sub-station would never deviate from the mean input, no matter how the load on the sub-station varied. Consequently, a measure of the power equalizing value of a storage battery is obtained by taking the amount of energy delivered to a station in excess of its average load, and dividing this by the amount of energy delivered by the sub-station in excess of its mean load. This is the quantity referred to as the efficiency of equalization. In the case of one of the batteries tested, this efficiency was determined to be about 12 per cent. It is evident that the property thus designated and defined is an important criterion of the commercial value of a storage battery in a distributing system. There are three main purposes that a storage battery subserves, viz.: (1) the reserving of power in case of breakdowns; (2) the regulation of pressure on the system; (3) the regulation of activity in the central station. The last item is one of prime importance. If the storage batteries on the system had sufficient capacity, the station could be operated continuously under unit load-factor. The less the capacity of the batteries, the more variable the demand on the central station may become, the smaller the load factor, and the greater the amount of idle machinery in reserve at the station. To a certain expenditure on machinery, or on batteries, pertains, at least in theory, the maximum economy.

Owing to the fact that pressure regulation is one of the functions of the storage battery, it seems desirable to change the name "efficiency of equalization" to "efficiency of power equalization," since a similar definition could be made for the efficiency of pressure equalization. The data accompanying the paper elicited the facts that in the distributing plant the efficiency of the high-tension system, including high-tension lines, transformers and converters, was approximately 75 per cent., and that the efficiency of the low-tension system, or 500-volt conducting network, also averaged about 75 per cent. This represents a larger absolute loss of power in the high-tension than in the low-tension system, although the percentages are alike. No particular conclusion seems to be forthcoming from this coincidence, that can be applied to systems generally. The case is a special one. There is urban traffic in half a dozen towns and interurban traffic over long lines connecting them. From generator terminals to cars, the joint efficiency is slightly over 50 per cent., so that for every kilowatt-hour delivered to the cars, nearly two kilowatt-hours have to be delivered at the central station switchboard. No doubt the relative economy of this distribution has been carefully considered in view of the low price of coal and the high efficiency of the generating apparatus. Moreover, an efficiency which might seem unduly low in an urban system with no feeder exceeding say five miles in length, would be very reasonable over an extended system in which copper would have to be poured in like water in order to raise the line efficiency in any marked degree. The average energy efficiency of the five storage batteries in the system appears to have been 89 per cent. This is an unusually high efficiency in central station work, 75 per cent. being about the average. It seems as if the conditions under which the tests were made must have favored the batteries to some extent. There is scarcely any test so difficult to carry out as an efficiency test of a storage battery under working conditions. A large number of cycles must be measured before much reliance can be placed upon the results, for the reason that it is so difficult to bring the battery at the end of the test to the condition it had in the beginning.

The same authors also contributed a paper on "Central Station Economies." In this paper the fuel records are tabulated for three successive days' operation of the power station. The coal and the water consumed were recorded and compared with each day's output at the switchboard. The mean result obtained was 4.28 pounds of coal per switchboard kilowatt-hour. It is pointed out that the consumption includes that of the auxiliary engines. If 15 per cent. be allowed for the auxiliary engine consumption, then the mean consumption per switchboard kilowatt-hour becomes 3.64 pounds of coal. Since, however, the auxiliaries must be fed, the former rate is the standard of reference, except where all the auxiliaries are electrically driven, and then the latter result becomes important. It is often very difficult to estmiate the consumption of the auxiliaries, and in some cases they are more wasteful than is suspected. The proverb—deliver us from our friends—becomes applicable to auxiliaries. The mean water consumption per switchboard kilowatt-hour was 36.8, including all auxiliary consumption. The efficiency of the furnaces and boilers in the three-day test was nearly 80 per cent. The efficiency of the engines was about 88 per cent. The total thermal efficiency was 6.4 per cent., reckining from the potential energy in the coal down to the switchboard. The efficiency of the transmission system was about 50 per cent. Allowing 70 per cent. for the efficiency of the motors and gears, only about 2½ per cent. of the energy of the coal becomes available at the motor shafts for driving the cars. Although such a condition, which is the ordinary state of affairs, is very regrettable, yet with coal at $1.35 per short ton, the cost of the energy for driving the cars can only be a small fraction of the total expense of the car mile. Or, stating the matter in a different light, if some process could be devised whereby the total electro-thermo-dynamic efficiency of the system could be raised from 2.5 to 40 per cent., the total cost of operation per car mile would not be very markedly reduced.

Death of Luther Stieringer.

LUTHER STIERINGER. IN 1902.

THE whole electrical fraternity in the United States is poorer by the death of Luther Stieringer, on Friday, July 17th, at Pasadena, Cal. Although Mr. Stieringer was only in his fifty-eighth year at the time of his death, his originally vigorous constitution had been showing signs of breakdown since the fall of 1900. Dyspepsia, accompanied by nervous hypochondria, then began to manifest itself, and many of Mr. Stieringer's old friends assumed somewhat hastily that the absence of his characteristic optimism was due to business worries, though it was in reality a well-recognized result of the malady from which he was suffering. In the summer of 1902, a heavy cold settled upon his chest, which failed to yield to the remedies prescribed by his New York physician. Acting under medical advice, he went South and West in November, 1902, resting for some weeks at El Paso, Tex., and going thence to Los Angeles, Cal. He then stayed for some months at Nordhoff, a quiet health resort in the foothills of Southern California. Some weeks ago his illness took a more serious turn and he went to Pasadena, where he was attended with unremitting care by a physician and a trained nurse. He was in touch with the outer world through Mr. A. W. Ballard, of Los Angeles, who kept Mr. Samuel Insull, of Chicago, Mr. Edward Clark, of Schenectady, and Mr. C. A. Coffin, and, through them his many other friends, fully informed by letters and telegrams of Mr. Stieringer's condition. The immediate cause of his death was consumption complicated with Bright's disease. His body has been cremated, in accordance with his dying wishes. The funeral was held at Los Angeles.

Luther Stieringer, though he achieved prominence in many different parts of the field of incandescent electric lighting, will be longest remembered for his marvellous power of mentally visualizing effects with artificial light before actual trial with the lights themselves. It was this quality that gave his services such an unique value to the projectors of expositions in this country. Next to Mr. Edison, to whose inspiration and fecundity of suggestiveness and analysis he was always proud to acknowledge his early successes were due, Mr. Stieringer was the first to grasp the enormous increase in striking effects in decorative or fête lighting made possible by the substitution of the electric incandescent lamp for gas, candles or oil. Exterior decorative lighting, with the elimination of wind and rain as limiting factors, assumed a new phase. Interior artificial lighting, both ordinary and decorative, was no longer trammeled by the need of a clear flame area with its attendant fire risk and blackened ceilings to be kept in mind. From this point on, the differentiation of artificial illumination into decorative and non-decorative proceeded rapidly.

In decorative lighting the objects sought were the outlining of structures; the artistic massing of lights; form, variety, color, contrasts. In non-decorative lighting, a perfectly uniform distribution of light was aimed at, the actual source of light being either concealed or rendered as inconspicuous as possible. Mr. Stieringer's reasoning upon this latter point was that the effect of light upon the human eye was purely relative, so that very bright points in the field of vision by contracting the pupil of the eye made other objects seem badly lighted by contrast.

Of Mr. Stieringer's success in Exposition lighting, for decorative purposes, etc., it is almost needless to speak in the columns of the ELECTRICAL WORLD AND ENGINEER, which has enjoyed so many admirable articles from his pen, or has itself described his excellent work. Though already under the shadow of his last illness, he conceived and laid down the lines upon which the brilliant success of the night illumination of the Pan-American Exposition, at Buffalo, was achieved, and this was fated to be his last monument in the field of decorative lighting. Mr. Stieringer contributed several valuable papers, to the various societies of which he was a member, on the growth and development of decorative lighting by means of the electric incandescent lamp, as well as on other features of electrical construction.

Mr. Stieringer's boyhood was passed in New Jersey, where his father lived in a house between Jersey City and Bayonne. He attended the public schools in New Jersey, and then served a short apprenticeship as a gas-fitter in New York City. He had a keen, inquiring mind, and was always an omnivorous reader, so that he was soon recognized by his employers as a workman of superior calibre. While yet a very young man, he was placed in charge of the choice pieces of work in his line in all parts of the country. Thus he was responsible at various times for the installation of gas fixtures at the Capitol, the White House, the Treasury Building, the State, Army and Navy Building, and other public buildings in Washington. He also did work in the residences of many of the prominent families in New York City, such as the Astors, the Vanderbilts, Mr. J. P. Morgan, the late A. T. Stewart, and others. During this period, covering the later sixties and all the seventies, his mind was not idle. He analyzed lighting effects wherever he saw them, and his reputation was sufficiently well established in the middle seventies to have had him called in on many occasions to arrange the scheme of lighting for large oil paintings.

Mr. Stieringer joined Mr. Edison at a very early stage at Menlo Park. His first work there was the adaptation of incandescent lamps and their connections to existing gas fixtures, and while doing this Mr. Stieringer took out several patents. His subsequent work lay largely in the exploitation of the incandescent lamp. As a pioneer in this field he had hardly an equal, and his reports, at once graphic and succinct, left nothing to be desired.

Mr. Stieringer has left behind him hosts of warm friends scattered through the United States, Canada and Europe. His rich mental storehouse was always placed freely at their disposal, and his vivid recollections of the early difficulties and triumphs of electric lighting constituted an unfailing source of interest to younger men. Mrs. Stieringer's death in 1897 was a great blow to him, from the sorrow of which it is doubted if he fully recovered. He leaves no family. After this sad event, he gave up housekeeping, and stacked up the relics of the art and the valuable technical literature and memorabilia to the enthusiastic collection of which he devoted a great deal of his leisure through many years. It is indeed to be hoped that his collections may not be dispersed, but handed over to some such trustee as the Institute, and bearing his worthy name.

Returning to Mr. Stieringer's technical work, it is difficult, of course, to determine its lasting value, but no doubt can exist as to its importance. He was a pioneer in the electric illuminating art, and successfully introduced many fundamental inventions of his own, of which three systems of interior wiring are now in universal use, as disclosed in the patents, to wit: combination lighting fixtures, electroliers, and a system of distribution and control for interior conductors, commonly known as the "cabinet system." This system is now the standard wiring system in all countries. He also invented and introduced the hard-end fuse and incombustible base and other useful inventions now recognized as standard devices required in light installations. He was a pioneer in the application and distribution of electric light more especially in large areas, such as expositions. The illumination for the Louisville Exposition of 1883 was planned and installed by him, this being the first exposition entirely lighted by incandescent light. The 1893 Chicago Columbian World's Fair illumination and electric fountains, as well as other prominent expositions since, including the Omaha Exposition of 1898, and the recent Pan-American, were designed and installed by him, he also holding the position of consulting electrical engineer in most of them. Medals and diplomas were awarded to him for many of these illuminations. He first introduced the outlining and accentuation of the buildings on a large scale with incandescent lamps at the Chicago Fair of 1893. The further development reached its climax at the Omaha Grand Court and surrounding buildings, the lighting being effected by small incandescent lamps. A specially minted gold medal and a diploma were awarded to him, this being the highest award made. He may justly claim to have, by persistent effort, introduced and demonstrated the value of a small unit of light as exemplified on a large scale at the recent Pan-American. Just before his death he was awarded the John Scott medal by the Franklin Institute for this work, but unfortunately did not live long enough to be a recipient of the award in person.

The Rateau Steam Turbine.

A TYPE of steam turbine which has come into considerable prominence abroad is that invented by M. A. Rateau, of Paris, and which is now being manufactured in France by Sautter-Harlé & Cie, and in Switzerland at the Oerlikon Works. Through the courtesy of the inventor we are enabled to give an account of the principles of this turbine, which we preface with a description of the construction of the machine.

In Fig. 1 are shown two of the bucket wheels, and in Fig. 2 several guides. Fig. 3 shows a turbine with the upper half of the casing removed and containing only the bucket wheels. Referring in general to the latter figure, live steam is admitted in a chamber to the left, and passing through ports or nozzles in a diaphragm, has its pressure transformed to jet velocity. The jets then strike the blades of the first wheel, then enter the first guide, passing thence to the second wheel, and similarly with respect to the remaining guides and wheels of the first stage. At the end of this stage the velocity of the steam jets is reduced approximately to zero. It then passes through ports or nozzles and starts on its second stage. In these nozzles the pressure, that is, the difference between the first stage pressure and exhaust pressure—is transformed into jet velocity as previously, and the same process follows that took place in the first stage.

The wheels of the second stage have a greater diameter than those of the first stage in order to reduce the depth of the buckets and also to maintain a proper relation between jet and peripheral velocity. The steam ports and nozzles only take up a portion of the circumference of the stage diaphragms; and in each stage the first guide plate has the least guide openings, each succeeding guide having a progressively increasing number.

The peripheries of the guide plates are fitted and secured steam tight to the turbine casing, but a clearance of from 5/32 to 6/32 in. is left between the shaft and the edge of the shaft opening in the plates. The clearance between the bucket and guide plates at the working portions is about ⅛ in. M. Rateau admits that there is a loss through friction between the surfaces of the bucket and guide plates which is absent in the Parsons system of steam turbine construction.

Regulation is obtained by means of a centrifugal governor acting on a valve in the admission steam pipe. In the case, however, of machines which are rarely called upon for full load, the width of the openings of the first stage nozzles is varied by an appropriate mechanism. When a machine may for a short time be called upon for a large overload, as in electrical generation, or when the exhaust is diverted from the condenser to the atmosphere, provision can be made for maintaining normal speed by an auxiliary supply of live steam at some intermediate point, such as at the beginning of the second stage.

Among the claims made for the Rateau turbine are: 1. High mechanical efficiency combined with the lowest possible angular velocity of bucket wheels. 2. Sufficient clearance between moving and fixed parts to allow for any possible wear of bearings and for shaft flexure. 3. Great lightness as a whole and particularly of the rotating parts, thus reducing gyroscopic effect to a minimum—this latter point being one of importance in turbines for marine use. As illustrative of the second statement, a machine of 1,000 to 1,200 hp does not exceed 1,100 pounds in weight.

For the following discussion of the theory of the Rateau turbine and account of tests, we are indebted to M. Rateau.

Before giving the figures obtained in the tests, it is convenient to define exactly efficiency, as that term is used by M. Rateau. Too often manufacturers or designers are satisfied by measuring the steam consumption either per indicated horse-power, or per effective horse-power, on the shaft, without giving the figures for the initial pressure of the steam and the exhaust pressure. This method of describing performance of a machine is not sufficient; one might just as well give for a hydraulic turbine only the quantity of the water without the height from which it falls.

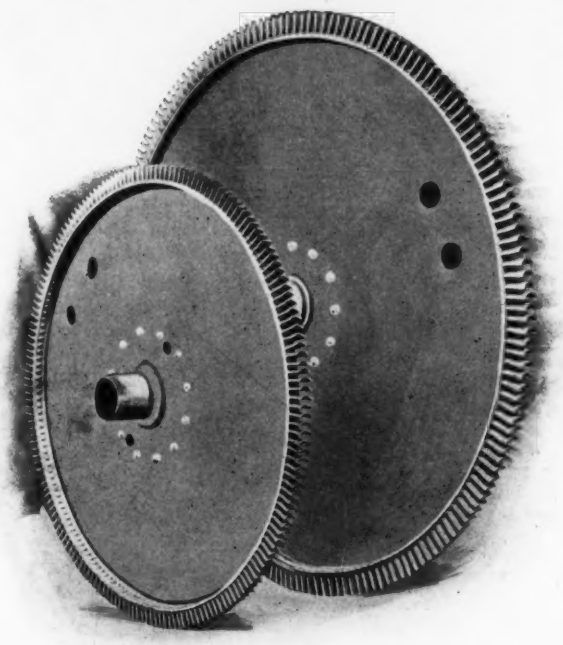


FIG. 1.—TWO BUCKET WHEELS.

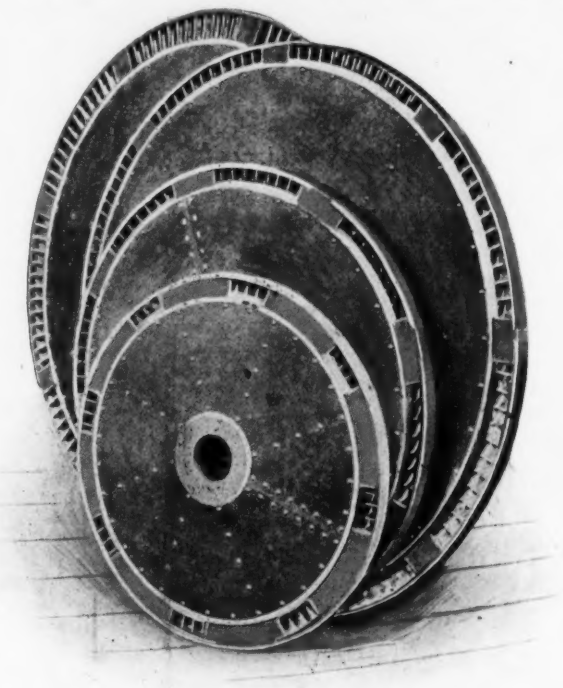


FIG. 2.—GUIDES.

In the tests from these turbines, M. Rateau determined the efficiency from the ratio of the theoretical steam consumption of an ideal perfect machine to the real steam consumption, referred to the power available at the shaft. In the case of electric generating sets, it is preferable to refer this real steam consumption to the electric power measured at the terminals of the dynamos. The theoretical steam consumption is defined as corresponding to the maximum work which the steam can produce under the conditions under which it is delivered to the machine, by expanding adiabatically and without losses from the initial pressure, P, to the exhaust pressure, p. This method presented some difficulty in calculation, but a diagram may be plotted from which the theoretical consumption can at once be found for saturated dry steam. Such a diagram shows how extremely important it is for economical operation, to have as perfect a vacuum as possible in the condenser, in order to diminish the exhaust pressure, p. The expansion is better and the steam consumption is considerably improved by better vacuum, as may easily be seen from the following example:

If a machine is using saturated steam at a pressure of 213 pounds per square inch and by exhausting into free air, the diagram shows that the theoretical steam consumption is 12.85 pounds per hp-hour; if we provide the same machine with a condenser which reduces the exhaust to 27 in., the theoretical steam consumption is only 7.82 pounds, i. e., 39.3 per cent. smaller than before.

Data will first be given of a turbo-generator of 540 electric hp, which is one of three similar machines, made in the Sautter-Harlé works for the Peñarroya mines in Spain, where they have just been installed. These consist each of two turbines of high and low pressure direct-coupled to direct-current dynamos, giving each at normal load 830 amp. at 220 volts. The normal speed is 2,250 r.p.m. These turbines operate with condensation which is effected by ejector condensers of the Rateau type. As the boilers give steam under pressure of from 140 to 210 pounds, a reducing valve maintains the pressure of admission at 140 pounds per sq. in. as maximum. The consumptions and the efficiencies are given in the following table:

	¼ full load.	½ full load.	Full load.	Over load.	Over load at 2,400 revolutions.
Electric hp produced (measured at the brushes)	135	259	525	627	641
Pressure in lbs. per sq. in. of steam admitted (gage)	31	61	121	141	141
Pressure in lbs per sq. in. of exhaust steam (lbs.)	1.247	1.34	1.64	1.82	1.82
Theoretical consumption in lbs. per hp-hour for a perfect machine	10.91	9.77	8.82	8.71	8.71
Consumption found in tests per electric hp-hour measured at the brushes	21.3	18.0	15.74	15.31	14.86
Combined efficiency of generating set	0.513	0.540	0.560	0.569	0.586

This table shows that the combined efficiency, i. e., that of turbine and dynamo together, varies between 51 and 58.6 per cent., while the steam consumptions per electric horse-power may be as low as 14.86 pounds. If the data are plotted it will show that the combined efficiency is practically constant, its variations being not more than 8 per cent., between overload and ¼ full load.

It has recently been claimed that with respect to efficiency and steam consumption, the turbines are economical only when operated at full load. The above example shows that this criticism is unfounded. In fact, the curve of steam consumption shows that the consumption at no load, with excited dynamos, is only about 10 per cent. of the consumption at full load (tests of other Rateau turbines have given figures varying between 8 and 12 per cent.). On the other hand, for an electric generator driven by a piston engine, the consumption at no load is between 15 and 25 per cent. of the consumption at full load, and these figures refer to the better types of machines of this class.

In the case of a turbine driving a four-wheel centrifugal pump working at from 90 to 140 hp, the combined efficiency of turbine and pump together was as high as 36 per cent., and did not fall below 31 per cent.; this corresponds to an efficiency of about 67 per cent. for the pump and 54 per cent. for the turbine.

By the use of condensing and by producing a vacuum of 24 to 27 in. in the condenser, it is possible to utilize steam at low pressure for the operation of turbines and to obtain quite satisfactory figures for steam consumption and efficiency. This is a considerable advantage of turbines over piston engines. In fact, if a machine of the latter type was to be operated with steam of a pressure of about 14 pounds' pressure, one would get an excessively cumbersome machine, too expensive to install, and of an efficiency which would be low for several reasons, the main reason being the very important condensing losses which would take place in the cylinders. This advantage of steam turbines has permitted Prof. Rateau to utilize the enormous quantities of steam which so far were wasted in mines and in plants equipped with powerful machines exhausting into the atmosphere and running at intermittent load. This is the case with hauling machines in mines, with machines in rolling mills, and with steam hammers. With these machines neither compounding nor condensing can be used, and the efficiency is, therefore, rather low. In any case it was very difficult to utilize the exhaust steam of these machines. They furnish an intermittent flow of steam, while a continuous jet is to be supplied to the turbine. M. Rateau has solved this problem by inventing an apparatus which he calls a "regenerative accumulator of steam." It consists of sheet iron cylinders, containing a series of cast-iron plates. This plays the same rôle for heat as a fly-wheel for kinetic mechanical energy; that it stores

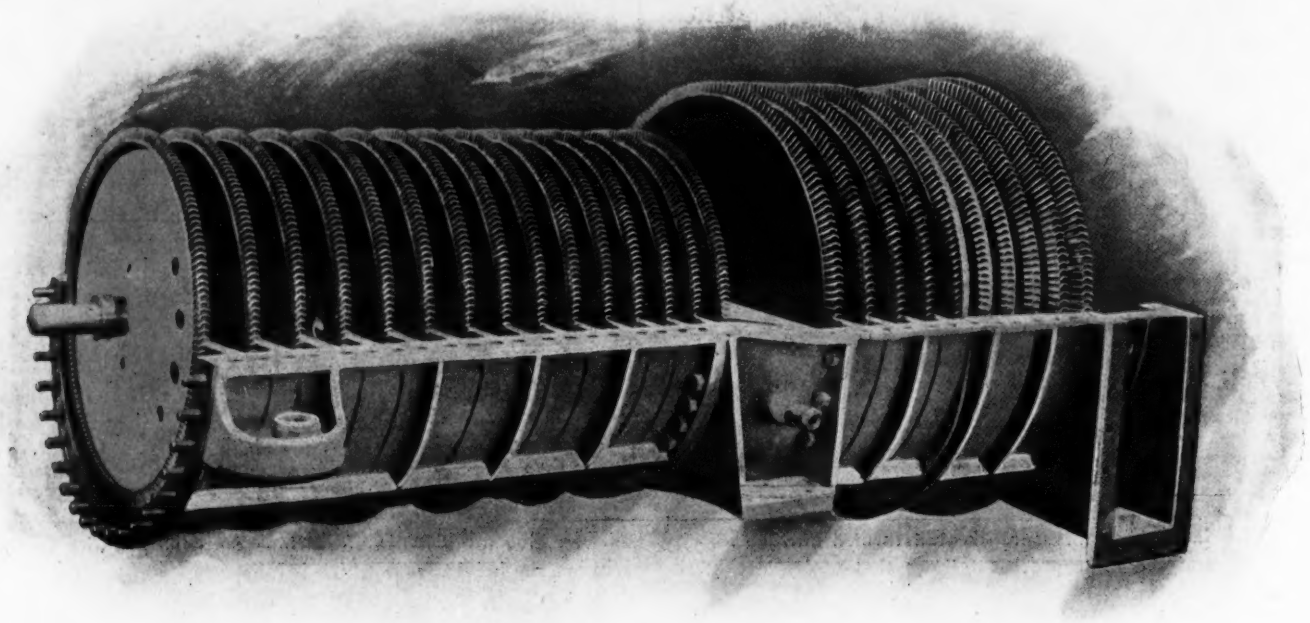


FIG. 3.—STEAM TURBINE WITH UPPER HALF OF CASING REMOVED.

it up, the steam being condensed at its arrival and being formed again later when the exhaust from the primary machine stops. The pressure of the exhaust steam is nearly constant, about 3 pounds. An adjustable valve, regulated by hand, permits to vary within certain limits, the pressure of the steam leaving the accumulator; in general this pressure is 2.8 to 5.2 pounds.

A very interesting application of this principle has been made at the Bruay mines at Pas de Calais. The exhaust steam of the hauling machine is fed to a turbo-generator of 300 hp. The tests showed that the machine gives 1 electric hp at the terminal of the dynamo with a steam consumption of 39.68 pounds per hour, the steam being admitted at atmospheric pressure and the vacuum in the condenser being 24.8 in., hence relatively bad. This figure could be reduced to 28 pounds per electric hp-hour with a better vacuum in the condenser, which is perfectly obtainable in practice.

Under these conditions the low-pressure generating set would perform about three times more useful work than the hauling machine; and even with a steam consumption of 39.68 pounds per hour,

the work performed by the turbine set is nearly three times that of the hauling machine, for the latter consumes generally 100 pounds of steam per useful hp-hour, this very high figure for consumption being normal for a non-compound hauling machine, exhausting into the atmosphere.

These are considered to be results of great importance, and the employment of low-pressure machines for the utilization of the exhaust steam of machines running at intermittent load, has apparently a great industrial future.

So far turbine-driven dynamos and turbine-driven pumps have been discussed, but it may be added that the turbine is equally applicable for driving ventilators, and, in fact, at present numerous turbo-ventilators of the Rateau system are in practical use. In view of the high speed of rotation of these ventilators, it is possible to supply the speed directly to the ventilator by mounting its wheel on the shaft of the turbine itself, and thus to obtain a turbo-air compressor. This construction gives machines much less cumbersome and less expensive than piston compressors. The Sautter-Harlé works have supplied such turbo-compressors to the French Navy and the British Admiralty, and at present they are building a turbo-compressor for use in the blast furnace of the Châtillon and Commentry Works. This apparatus will give 88.3 cu. ft. of air per minute at a pressure of 4 pounds.

A turbo-ventilator when running at a speed of 20,200 r.p.m., has given a back pressure of more than 7 pounds per sq. in.; this pressure was obtained with a mechanical efficiency of about 60 per cent.

The figures given for the steam consumption and efficiency of the turbines show that these machines have now reached a remarkable degree of perfection and that their efficiency is superior to that of compound machines and even comparable to that of the better types of triple-expansion machines. From day to day they become of greater industrial importance, being gradually substituted for piston engines on land, while for some time there has been a tendency to substitute them for the latter even on board ship.

Interesting Features of American Electric Railway Work.

Note has already been made in these pages of the leading data presented in the United States Census Office bulletin on American street railways, just issued. The report contains a variety of interesting figures and information, full of suggestion and guidance as to what has been done in the art and as to its present tendencies. The whole report is a most remarkable exemplification of what electricity can do in stimulating an industry, for it is inconceivable that any such growth as is manifested in the figures already quoted last week could have taken place with animal power, while the limited applicability of the cable would also have been against such universality of use as has characterized the electric current. Moreover, it is noteworthy that other once competitive powers with electricity, such as gas and compressed air, have quite disappeared from the scene. The recent statements in regard to the cost of compressed air trials on the New York Metropolitan Street Railway system, give the reason why.

As regards the gains in the period or decade under the electric régime, the total reported cost of construction increased $1,778,276,788, or 456.7 per cent., as compared with an increase of $1,830,046,142, or 382.7 per cent., in the combined par value of the capital stock and funded debt. While the percentage of increase for the capital stock, 355.1, is smaller than that for funded debt, the actual increase in the par value of the stock was $1,026,514,827, as compared with an actual increase of $803,531,315 in the amount of funded debt. The increase in both capital stock and funded debt is due very largely to consolidation of independent roads and the operation of roads under the lease system, where the stock of the constituent and underlying companies is not retired.

The increase in earnings from operations was $156,936,788, or 173.2 per cent.; the increase in operating expenditures was $80,301,412, or 129.5 per cent. The percentage that operating expenditures formed of the total earnings from operations was 68.43, in 1890, as compared with 57.49 per cent. in 1902. A special table in the report gives information concerning the percentage of operating expenses to earnings from operations for the companies in the different States and Territories.

The increase in the number of passenger cars amounted to 27,785, or 85.5 per cent. In connection with the increase in the number of cars, the increase in size, made possible by the introduction of electrical power, should be taken into consideration. This is doubtless indicated by the increase in the number of passengers carried per car. The number in 1890 was 62,237, and 1902, 79,774, an increase of 17,537. The number of employees, exclusive of salaried officials and clerks, increased 62,877, or 88.9 per cent. The report in giving detailed accounts of this kind, states that the decrease in the length of line operated by animal, cable or steam power has been attended in every instance by more than a corresponding increase in the trackage operated by electricity. As to the use of the service by the public, it appears that in the United States in 1890 the average number of rides per inhabitant was 32 and in 1902 was 63, a gain of 31 per head. But in some sections of the country the gain was much greater than that, as, for example, in the North Atlantic States, where it rose from 66 to 124, or just again doubled itself. For the whole country the traffic earnings in 1902 were $247,553,999, and the number of fares was 4,809,554,438. This income from operation is not, however, wholly from passengers, that amount being $233,821,548, with enough from chartered cars to make it just over 234 millions. As this amount includes all the interurban traffic, the average fare is obviously less than 5 cents. Looked at in another way, on the basis of the population of 1900, or just 76,000,000, the average expenditure per inhabitant of the United States for street car travel is just over $3 per head. In the report published last year on electrical apparatus and supplies by the present writer, who has also been engaged as expert on the street railway census, the amount per head derived from the public by the traction companies, it was predicted "would reach not less than $3 per head."

Other figures of income and expenditure have already been noted, and need not be again referred to here. As to the employees, some interesting data can be gleaned from the report. Of the total number, 133,641 employees, 80,144, or 59.97 per cent., were conductors and motormen, who received $48,642,359, or 60.22 per cent. of the total amount paid in wages. The next largest group of employees is road and track men, which includes laborers employed in reconstruction and repair of the road. The 11,474 employees reported for this group were 8.59 per cent. of the total and their wages amounted to $5,511,425, or 6.82 per cent. of the total wages. The number of employees reported includes, however, employees working in electric light and power plants, operated by railway companies, and, as such employees are engaged indiscriminately in the two branches of work, the total number cannot be accepted as the number employed exclusively in the operation of street and electric railways.

The reports for 669 electric railways located in different sections of the country include also 94,874 wage-earners, or 70.99 per cent. of the total for all companies. The distribution of this large proportion of employees at the different daily rates of pay indicates very closely the prevailing rates of wages in the industry. For all classes taken together the prevailing rate of wages is from $2 to $2.24 per day, 39,678, or 41.8 per cent. of the total, being paid at this rate. It appears that 65,297 wage-earners, or more than two-thirds of the total, receive from $1.75 to $2.49 per day. More than half of the conductors and motormen receive from $2 to $2.24 per day. The prevailing rate for road and track men, which includes a large number of laborers, is $1.50 to $1.74 per day, nearly one-half of the total number being reported at that rate.

Turning now to line construction, it is interesting to note that of the 21,920.07 miles of single track operated by electric power, 21,302.57 miles, or 97.18 per cent., obtain the current by means of an overhead wire. The methods of supporting this wire are shown in Table 27, from which it appears that, of 15,857.26 miles of construction reported, 10,220.07, or 64.45 per cent., is supported by span-wire construction; 5,223.08 miles, or 23.83 per cent., by side bracket, and 414.11 miles, or 2.61 per cent., by center pole. Wooden poles were used for 80.27 per cent. of this mileage, and steel or iron poles for 19.63 per cent. There were 15.92 miles of line having wires supported by elevated railway structures and by buildings and bridges. The average number of poles on each mile of line ranges from 30, reported for the Salem Electric Railway Company, of Salem, Ohio, to 85, reported for the Duluth-Superior Traction Company, of Duluth, Minn. There were 24,754.29 miles of feeder wire construction reported, and of this mileage 22,343.22 miles, or 90.26 per cent., was overhead and 2,411.07, or 9.74 per cent., underground —a very small proportion. This form of construction was used by 27 companies. The statistics for the conduit system are intended to cover only the conduit system employed by the street railway com-

panies for the reception of their mains and feeders. The schedule called for miles of duct, and the inquiry was designed to ascertain the number of miles of separate pipeway, each pipeway receiving one cable of wire. One mile of street laid with conduit of 6 holes would thus represent 6 miles of duct. There were 6,546.9 miles of duct laid ready for use, occupying 589.3 miles of street. Of this, 3,905.1 miles of iron pipe and 660.4 miles of wood or other material. The use of underground construction predominates in Washington, D. C.; Chicago, Ill.; New York, N. Y.; Boston, Mass., and Philadelphia, Pa.; these 5 cities, containing 5,462.3 miles, or 83.43 per cent. of the total for the United States.

As to the cars employed, some details were given in these pages last week concerning motor equipment, lighting, heating, etc. There were 66,784 cars of all classes reported. The largest number—3,612—reported for a single company is given for the Boston Elevated Railway Company, of Boston, Mass., which includes cars operated on both surface and elevated tracks. There were 60,290 passenger cars and 6,494 cars used for express, work or other purposes. Comparing the number of passengers carried and the passenger-car mileage with the number of cars, it appears that each car carried on the average 79,774 passengers and traveled 18,001 miles during the year, or nearly 50 miles every day in the year. Of the passenger cars, 32,658 were closed and 24,259 open. Combination closed and open cars were reported by 106 companies, the total number being 3,134, of which 1,203, or 38.38 per cent., were used by 22 companies in California. Combination passenger and express cars were used by 99 companies, the number being 239. Cars used for more than one service were enumerated only once; for instance, cars carrying passengers as well as material and mail were classified as passenger cars. The use of express, freight or mail cars was reported by 206 companies, the largest number being shown for the St. Louis & Belleville Electric Railway Company, of Belleville, Ill., an interurban freight line operating between East St. Louis, Ill., and Belleville, Ill. The 1,727 snow plows reported do not include snow plow attachment, but only snow plow cars. Similarly the 790 sweepers include only sweeper cars. Cars used both as sweepers and as snow plows were counted only once, either as plows or as sweepers. There were 50,699 cars provided with electrical equipment; and as the roads operated either in whole or in part by electric power reported a total of 64,618 cars of all classes, the number having equipment of this character was 78.46 per cent. of the total.

Of the total car mileage, 1,099,256,774, the passenger cars traveled 1,085,397,802 miles, or 98.74 per cent., and freight, mail, or other express cars 13,858,972, or 1.26 per cent. In computing the car mileage and the car hours, where a road operated one or more trailers, or, in some cases, a train of cars, the entire combination was considered as one car. The total, therefore, contains a certain amount of train mileage, and allowance should be made for this fact in considering the average fare passengers per car-mile and car-hour. The fare passengers per car mile for all companies averaged 4.43 and ranged from 0.01 for the Chicago General Electric Railway Company, of Chicago, Ill., to 69.15 for the Monongahela Incline Plane Company, of Pittsburg, Pa. It was impossible to obtain information concerning car-hours from a large percentage of the companies. However, 389 companies furnished this information. Their total car-hours for the year amounted to 65,869,342, of which passenger cars formed 65,403,287, or 99.29 per cent., and freight, mail, express and other cars 466,055, or 0.71 per cent. The fare passengers per car-hour for the companies reporting both factors averaged 33.28, the highest figure being 89.24 for the Worcester & Southbridge Street Railway Company, of Worcester, Mass. No fewer than 286 companies reported that they were carrying mail, and the companies in the aggregate reported the owning and operating of as many as 350 pleasure parks.

The following statement reproduces the totals concerning the number of persons killed and injured in the United States:

Class.	Killed.	Injured.
Total	1,216	47,429
Passengers	265	26,690
Employees	122	3,699
Others	829	17,040

"Others," referred to in the above statement, include persons on foot or riding in vehicles other than street cars who were killed or injured in collision with street cars. The number of persons reported as killed, 1,216, and injured, 47,429, form only an inappreciable percentage of the total number of passengers carried, and present electric traction in that respect also in a very favorable light.

Proceedings of Niagara Meeting of the American Institute of Electrical Engineers. (*Concluded.*)

THAT part of the Niagara Institute programme which elicited by far the widest discussion was the group of papers on high-tension transmission subjects. These contributions, in fact, were prepared in such form as to serve specifically as introductions to discussions, and thus departed somewhat from the usual character of Institute papers. The preparation of the programme was confided to Mr. Ralph D. Mershon, chairman of the Committee on Collection of Data on Transmission, and it was largely through his efforts that the discussion at Niagara was so successful. At his suggestion an adjourned meeting for continuation of discussion was held on the afternoon of the day when the papers were read, and all of those particularly interested in the subject of the papers were asked to forego a trolley ride on the regular programme and attend this meeting. The large number who accepted that invitation and the great interest shown at the meeting, rendered it one of the most successful of any the sessions held during the week.

Mr. C. E. Skinner, in a paper entitled "Methods of Bringing High-Tension Conductors into Buildings," discussed the general requirements for bringing high-tension conductors into buildings. The requirements which must be met are the maintenance of proper insulation of the circuit, the prevention of the entrance of rain, snow, cold air and dust, the proper mechanical fastening of the line wire, reliability and simplicity of construction. In general, wires are best brought through the walls of the building. The simplest form of construction consists merely of an opening in the wall sufficiently large to allow the proper air insulation between the wire and the wall, this opening being suitably protected from rain either by means of a large pipe set in the wall, sloping outward or by a sufficient extension of the roof above, or both. The wire must be at a sufficient distance from the pipe. The pipe should always be considered as "ground." The cross arms holding the wire inside and outside of the building should be sufficiently near and so braced that the wire will remain central in the pipe. With potentials of 15,000 volts or lower a disc of glass or other fire-proof insulating material is placed over the wire at the inner end of the pipe. The tube must be sufficiently large so that the surface insulation over the insulating disc used will be ample to prevent trouble under the worst conditions. When there is any danger of condensation of moisture due to differences of temperature inside and outside of the building two discs a little distance apart should be used. Their surface insulation should never be less than that of the line insulators. For voltages above 15,000 volts, a long insulating tube of small diameter and very heavy wall may be placed over the wire and passed through a slab of insulation set in the wall of the building, the whole being protected from driving rain by an extension of the roof. The insulating tube should slope outward in all cases. Some form of drip point should be provided on the wire just outside the end of the tube. The insulation slab holding the tube should be large enough to prevent actual break-down even though the tube is broken. Both tube and slab should be of fire-proof material. This form of construction has been successfully used for potentials as high as 50,000 to 60,000 volts.

Mr. Skinner read a communication by Mr. Floy, who considers that the use of glass plates or of conductors insulated for a portion of their length (as in the two schemes advocated by Mr. Skinner for bringing the wires into a station) is objectionable, because of the constant menace of leakage and grounding of the system through the wall of the building. Mr. Floy believes there is nothing quite equal to a plain but generous hole in the wall through which the wire rigidly supported may pass; he gave a sketch of a construction in which the wire first passes vertically through the floor of an overhanging gallery which is an extension built on the side of the building; the wire then passes horizontally through a hole in the wall into the building; the gallery is used as a place for the lightning arresters. All water drips from the wires before the latter turn vertically to pass through the floor of the gallery; and the two apertures being at right angles to one another, prevent any large amount of cold air entering the building.

Mr. Skinner then read a communication by Mr. O. H. Ensign, chief engineer of the Edison Company, of Los Angeles, Cal. He uses for 30,000 volts plain open 12-in. sewer pipe. He does not believe that any sort of closed plate insulation would do.

In a brief communication by Mr. A. L. Mudge the writer suggests

that the terra cotta pipe, mentioned in Mr. Skinner's paper, should be closed at the outer end to prevent birds and insects getting into and building nests in the pipe.

Mr. F. C. Pierce, of Philipsburg, Mont., does not believe in allowing the wall of the building to take the strain of the line; the last poles of the line should be guyer. He gave some details of construction, used by the Montana Water, Electric Power & Mining Company.

Dr. Louis Bell thinks that a mania for compactness has been responcible for more trouble in high voltage-systems than any other cause. Wire towers for high-potential lines should be avoided. The high-voltage wires themselves and all their connections should be so placed that their whole arrangement is evident at any time from a cursory glance.

Mr. J. Harisberger, of Seattle, Wash., states that the Snoqualmie Power Company, adopted at the very beginning the second arrangement suggested in Skinner's paper, and with all of its high-tension troubles it has yet to experience its first trouble with this style of construction for entering buildings. In some of the buildings where the wires enter with the first construction, suggested by Skinner, in every instance when the high-tension lines became grounded for one reason or another, there was a discharge across the glass plate to the terra cotta pipe.

Mr. H. M. Gerry, Jr., gave a review of various methods used in practice, and said there can be no one method of entering high-tension wires; it is always a question of engineering detail which should receive special treatment in each particular case.

The foregoing were all written communications. In the oral discussion of Mr. Skinner's paper which followed, Mr. Mershon said that by experience he had come to feel somewhat afraid of the use of glass tubes. The climatic conditions determine details of construction.

Mr. R. F. Hayward described some methods used in Utah; on account of the climatic conditions they have to keep their wires much further apart than in the East. Good glass tubes may be had and have proven satisfactory, but porcelain tubes are better. He thinks that people do not appreciate how effective in practice a simple piece of plate glass is. On 16,000 volts he used a piece of 12-in. plate glass with a ¾-in. hole drilled in it with wires passing right through, and has never had the slightest trouble, in spite of frequent storms in winter. The most important thing in outlets is to provide much space and not to cumber the outside of the building with any extra structure.

Mr. V. G. Converse criticised some special points in Mr. Skinner's suggestions. Porcelain tubes are much preferable to glass tubes. A rain shed should be provided. Mr. P. H. Thomas concurred in the latter proposal; he also suggested mounting the true high insulating inlet in an insulating panel. Mr. P. M. Lincoln recommended that the line end strain should be taken up by a strain insulator inside.

Some of the transmission lines of this country have installed upon them as a protection against lightning one or more wires strung parallel to the power wires and grounded at intervals. As there is a difference of opinion amongst electrical engineers as to the efficacy of this device, Mr. Ralph D. Mershon, in a paper entitled "The Grounded Wire as a Protection Against Lightning," discussed the problem of its advisability. He first gives the theory of the subject and calculates the "shielding action" of the ground wires for a special numerical case. If each wire of a transmission line 20,000 ft. in length, the conductors of which consist of No. 00 wire, has stretched parallel to it and at a distance of 12 inches, a grounded wire equal in size to the line wire, the potential of the line wire due to a charged cloud could not rise to exceed 30 per cent. of the value to which it would rise if the grounded wire were not present; this is given only as a rough example to show the magnitude of the effect of the grounded wires. The author refers briefly to the material and dimensions of ground wires and to their method of installation, and gives some results obtained in practice in various plants. In one plant as the result of a number of years of operation, those in charge feel sure that the grounded wires furnish a reliable and effective protection against lightning. In some of the other plants those operating think that the grounded wires furnish more or less protection, but are doubtful as to the amount. In still other plants those in charge feel sure that the grounded wires are of no value whatsoever and constitute a muisance and menace because of their liability to break and fall across the power wires. In some of the cases of doubtful success or failure the trouble may have been due to poor grounds or to the wires not having been grounded frequently enough, as in some of these cases the wires were not grounded at every pole. In all of the doubtful cases lightning arresters which were installed in addition to the grounded wires received more or less discharges during thunderstorms.

In the discussion of Mr. Mershon's paper which followed, Mr. R. S. Kelsch gave an account of a careful record undertaken in Montreal, when a great many light and power wires of a company were constructed below the wires of other companies; it was found that the greatest amount of trouble, such as transformer burn-outs, etc., caused by lightning, occurred on the circuits that were built under the lines of other companies.

Dr. Perrine discussed the use of barbed wires for grounding. When a cloud has discharged in the neighborhood of a line, and the line and its accompanying guard wire have reached a stationary condition, the points on the grounded wire tend to aid the release of the charge. The trouble is, however, that in practical operation the barbs form points of mechanical injury, as the wire may be twisted and kinked around the barb.

Mr. C. O. Mailloux referred to a three-conductor line in Arizona, 25 miles long, with only three lightning arresters, one at the transmitting end, one at the receiving end, and the third at a second power plant about 8 miles from the receiving end. This line was started last fall and has worked without interruption; although there were many lightning storms, they had never any trouble from lightning. There were discharges over the lightning arresters, but the operation of the line was never interfered with.

Mr. A. J. Wurts looks on the entire situation as a cloud and the earth forming the two terminals of a huge static machine. He considers the lines over the earth's surface, electric lines, grounded lines, railroad rails, gas pipes, water pipes, all a part of the one terminal of the machine. He does not believe that a grounded wire in the neighborhood of an electric line will materially protect that line; they will all discharge.

Mr. Thomas stated that the data at hand concerning lightning protection are still very poor. We have no decisive experience yet as to whether a grounded wire really affords any protection. Besides the electrostatic induction, there is also electromagnetic induction. He thinks there should be an appreciable loss due to the grounded wire. The problem is very complex and one should go very slow in putting too much at stake on grounded wires.

Dr. Perrine pointed out that there are several things to protect against. One is the gradual charge and discharge of the line due to conditions of the atmosphere. The line may gradually acquire a charge from the wind blowing over the line when there is no lightning in the neighborhood; it is against this form of trouble that the guard wire is intended to guard. On the other hand, it is not of any great advantage where there are lightning discharges of severe character.

Dr. Kennelly referred to the long years of experience on this question in the protection of telegraph and telephone lines; among telegraph men it has always been a popular impression, derived from long experience, that the presence of other wires protects the neighboring wires against direct lightning effects. The tendency in a working wire is to carry the earth up over that wire or in the vicinity of that wire and to produce partially that effect which a completely grounded wire produces more thoroughly. If we only have enough parallel wires above and around a working wire, we carry immunity to the latter. Whether it is worth while to do so is a very important question. When some years ago he collected information of this character from the representatives of local stations, he found the evidence to be in favor of protection by means of a guard wire.

Mr. F. S. Woodward referred to a case in which barbed wires had been used and remained in good condition for about two years; at the end of that time they broke and there were a number of short circuits owing to the wire falling over the line. On this same line there were some lightning arresters and an investigation of them at regular intervals showed that they were very frequently acted, so that the barbed wires themselves did not prevent the lightning stroke from striking the line wire.

Mr. Rushmore referred to the effect on a transmission line, due to differences in altitude between different parts of the line. This effect is evidenced by injury to the insulation at the lower altitude. He referred to a case in which one part of the line is about 7,500 ft. above sea level and the other part about half that altitude; the insulation remains good on the higher part and does not hold up at the lower part. Guard wires may protect the line against this effect.

Mr. John F. Kelly believes that the main protective effect of the grounded wire is not against lightning discharges, but principally against the ordinary atmospheric electricity. He referred to troubles due to the latter, experienced on an old telegraph line. The most important point in Mr. Mershon's theory is that the wire should be equally effective if placed below the line, as if placed above. The great danger heretofore has been that it was above and in breaking would fall on the transmission wires. He believes that there may be some protective effect from the grounded wire, but it does not pay for the complications.

Mr. Hayward stated that the Committee on High-Tension Transmission has sent word to every operating engineer, asking that every one of their engineers be made an observer; in the case of a breakdown from lightning, the engineer is to go right to the spot as if it were a fire, and collect all the evidence. In this way it is hoped that in a year or two a large amount of exact data will be collected. He believes that the locality has much to do with the nature of the discharges. He thinks that overhead grounded wires, such as telegraph and telephone wires, are a protection; they have never lost a transformer in their business section, which is the most thickly covered with other wires; but they are not a complete protection by any means. If one would absolutely surround the transmission wires with a grounded network, they would be protected, but this method is absolutely impracticable. The transmission line must be easily accessible. They have made careful records of their troubles from lightning; their troubles always come at the moment when the lightning discharges. Troubles due to the raising of the potential of the line when there is a dust storm, or wind storm, or a thunder cloud, are taken care of by the lightning arrester. Every single occurrence that has given them trouble has been at the moment of the lightning discharge. In recent times, while they have had arresters in connection with spark-gaps, they never had any trouble with the lightning arresters themselves.

President Scott remarked that Mr. Hayward has duly emphasized the point that the men in the laboratories, the men who are building apparatus, need the co-operation of the men who are experiencing difficulties on the ground; the two must work together.

Mr. Waters suggested another method of calculating the conditions, different from that used by Mr. Mershon. He gave some results of his experience on European mountain lines of short length, the voltage being between 5,000 and 1,000. Troubles arise there usually from violent lightning storms and from heavy sleet and snow storms. The universal opinion of the operating engineers there is that the grounded wire is more trouble than it is worth.

Prof. D. C. Jackson expressed the opinion that the numerical example in Mr. Mershon's paper does not represent the commercial conditions in a long transmission line. Instead of estimating the protection from the guard wire at something like 70 per cent., as Mr. Mershon does, he thinks 7 per cent., or one-seventh of 1 per cent. would come nearer the truth.

Mr. Mershon, in his reply, said that his numerical example was not so far off from the actual conditions in some lines. In his paper he did not deal with electromagnetic, but only with electrostatic action. He agreed that the ordinary guard wire cannot furnish much protection against electromagnetic action.

Mr. N. A. Blanck stated that in most cases on recent Italian lines, as also on the German lines, the lightning arresters are used in the stations, never on the line itself, and the use of iron wires for protecting the line itself has been abandoned.

Dr. Perrine said he had tried to measure the loss due to the grounded guard wire, but was unsuccessful in his attempt.

"Y or Delta Connection of Transformers," was the subject of a paper by Mr. F. O. Blackwell, which discussed the comparative advantages and disadvantages of the two alternative methods of connecting transformers to a three-phase system. The comparison is made under the following headings: Size of transformers required; grounding the neutral; unstable neutral; rise of potential. The selection of Y and delta connection of transformers for long-distance transmission should only be determined after a careful consideration of the conditions in each case. There is little choice between Y and delta without a grounded neutral. In small installations, the cheaper cost of transformers for Y with a grounded neutral will be a determining factor. Larger plants will be guided by the greater importance of giving uninterrupted service and will not employ a grounded neutral unless demanded on the score of safety. Where the amount of power is great and the system extensive, delta connection will be generally preferred on account of its avoiding the possibility of rises of potential from any cause. Many plants can have advantageously a mixed system with both Y and delta transformers, each installation of transformers being considered by itself.

Mr. J. S. Peck, in a paper entitled "Grounded and Underwound Transmission Circuits," discussed the problem of grounding a transmission system with reference to Mr. Blackwell's paper. By the grounding of the neutral point it is sought to limit the strain from line wires to ground and to limit the strain between high-tension and low-tension windings of the transformers, also between high-tension windings and iron case. The author discusses in detail with the aid of diagrams the effect of grounding on the various possible polyphase systems and sums up his results in a long table. In many cases the grounding of the neutral points of a transmission system limits the voltage strain to ground and the voltage which may be obtained across any transformer, and in such cases grounding would seem advisable. This is notable in the case of the star system with grounds on transformer and generator neutrals. There is, however, the danger arising from this grounding that in case of trouble on the circuits current may flow through the ground to the neutral; in thus flowing it will naturally take the path of least resistance, so that if telephone or telegraph lines, which have normally low resistance to ground, parallel the transmission circuit, the current will flow along these wires, often with disastrous results to the circuits. Two cases of trouble are particularly liable to occur: First, where the neutral points of the high-tension windings of raising and lowering transformers are grounded, the opening of one or two of the three transmission wires will cause currents to flow through the ground; second, a high-resistance ground on a transmission wire will partially short-circuit a transformer and cause current to flow through the ground to the neutral. Some plants have been able to operate satisfactorily with grounded neutrals; with others this grounding has caused great disturbance on telephone circuits, and in one plant it is reported that the blowing of a fuse on one of the high-tension wires put out of service the telephone systems in "ten counties." Thus, while grounding of neutrals may be permissible in certain localities, it may not be allowable in others; and in laying out a plant it would seem to be advisable so to arrange the apparatus that it may be safely operated without grounding the neutrals. An examination of the tables given by the author indicates that the delta system is the one giving the minimum chance of trouble. Under certain conditions, however, the star and star-delta systems will give satisfactory service.

The discussions of the papers of Mr. Blackwell and Mr. Peek was opened by President Scott, who called the attention to the fact that the question of grounding or not grounding the neutral is not at all settled yet; there are diametrically opposite opinions held by practical engineers concerning it, neither one with full reason or the ability to answer the position of those who operate in the other way. It is a peculiar fundamental question, partly theoretical but largely practical.

Mr. Haywood who has operated his 17,000-volt lines without grounds, said his experience was, of course, that one may have a short circuit on one wire, and with the wire down, one could still keep running. Yet he believes that when one gets up to any very high voltage it is better after all to ground the neutral and keep them grounded everywhere. The lines must be made so that they will not break down. The conditions worked out theoretically by Mr. Blackwell and Mr. Peck for possibility of troubles, are not merely theoretical, they will and do occur in practice.

Mr. Gerry believes one may get perhaps equally good results by the use of either delta or a Y-connection on a transmission line. The points, brought out by Mr. Peck are very real, but means can be taken in the construction of a plant and in the arrangement of the transformers to void practically all the serious conditions outlined by him. It is possible to so connect the transformers in star that one transformer cannot be cut out without practically all three coming out at the same time; and when transformers are connected in that way, with the neutral grounded, it should always be done. The star connections of the transformer should be permanent and fixed, so that one transformer cannot be cut loose from the other two, and a reverse can be arranged with reverse apparatus. On the other hand, it is a question whether the star connection is desirable; while one gains something in the design of the transformer, yet this is a small advantage. He discussed some secondary operating advantages of the delta connection.

Mr. Nunn described the troubles which his company has had. The most severe accident was, when operating its 40,000-volt system the current once jumped from the conductor eight feet to the steel frame work of the roof; he knows the fact, but not the conditions which caused it. Many of the troubles were due to the peculiar local conditions of the plant. He gave a great many details concerning its operations and the construction of insulators, and concluded by stating that he cannot better sum up his decision after his five or six years of experience with 40,000-volt work than to say that he does not know, and that there is a lot about it that he does not know and cannot even guess at.

Mr. Thomas analyzed in detail the conditions of resonance at normal generator frequency and at very high frequencies. Mr. Lincoln referred to a contribution by Pupin in which he showed how very difficult it is to maintain resonance with iron in the circuits; he showed that when there was no iron in the inductance coils, resonance was very marked, but as soon as iron was introduced into the coils, it was very difficult to obtain resonance conditions.

Mr. Junkersfeld referred to moderately high voltage transmission lines, such as used in our large cities. In Chicago they have been operating a four wire, three phase, 60-cycle overhead system with a grounded neutral for about three years; the generators are star connected, and the common point is connected to the ground. It has been very successful from the start. They ground in the station only and do not ground any other point of the primary system. The neutral of the secondaries is also grounded. In their underground system, which is operated at 9,000 volts and 25 cycles, they likewise operate now with the grounded neutral. For the first four or five years, while the voltage was only 4,500, they had step-up transformers with delta connections; the next step was to double the voltage and install line voltage generators which are operated with the grounded neutral with very satisfactory results. He emphasizes the necessity of doing away with single-pole switches and fuses. They have had very few transformer troubles. With the increase in the number of transformers, they have come to the conclusion that the advantage of having delta-connection transformers—in order to be able to cut out one of the bank and operate with two—is not very great. They have now gone over to Y-connection and are installing three-phase transformers, the idea being that with these accidents occur very rarely, and when they occur, one can afford to have a whole unit shut down.

Mr. Gerry thinks there is some advantage in using a delta-connected system; one may use single phase switches and one avoids the excessive potentials mentioned by Peck. When satisfactory and reliable swithches are on the market for opening all three legs of a circuit, one may go over to star connection but whether he shall then desire to do so, is another question.

Mr. Woodbridge, in a written communication takes up the special case of high-tension power distributed for the operation of rotary converters. In distributions of this kind the secondary voltage of the step-down transformer is so low that there is no advantage in a Y-connection of the secondary coils; in fact, this would prove a positive disadvantage. For this reason a delta-connection of the secondary windings is to be preferred for three-phase converters. With the primary windings connected Y and and the secondaries delta, in operating synchronous machinery there is no instability of the neutral. After a detailed discussion of the various points which must be taken into consideration, he reaches the conclusion that extra high voltage systems, i. e., those with a working pressure between wires of over 25,000 or 30,000 volts, should have the high-tension windings of their step-up and step-down transformers Y-connected and with the neutrals grounded.

Dr. Louis Bell, in a written communication, concurred with Mr. Blackwell's conclusions. The Y systems, which are immensely valuable in saving copper, also entail some additional care. In practice he has found that mixed delta and Y converters are desirable and tend to to steady the regulation. He believes in the grounded neutral as a safety measure, but sources of accidental grounds should be followed up rigorously and carefuly eliminated.

Mr. P. H. Thomas, in a paper entitled "The Testing of Electrical Apparatus for Dielectric Strength," pointed out that while the only practical method of testing high-tension apparatus is by means of over potential tests, yet the latter involve dangers, and great care should be taken to avoid injury to the apparatus, and excessively severe tests, especially long-time tests at high potential, should be avoided. A disruptive test fails partially of its object in testing the fitness of the apparatus for actual service, because the conditions of the test do not approximate closely the conditions of the service, either normal or emergency conditions. In general, electrical apparatus is never in a condition so poorly adapted to stand dielectric strains as when first installed. Insulation tests require special testing apparatus and expert and experienced direction which are very often not available and without which great risk is run in attempting such tests; as an exception it may be mentioned that some simple types of apparatus, such as high-tension series transformers, high-tension bus-bar insulation, etc., may be readily tested without great danger.

Among the specific practical suggestions, made by the author, for tests of dielectric strength are the following: In high-tension apparatus, e. g., 20,000 volts and above, only moderate, short-time, over-voltage tests should be specified in contracts. Such tests should be used once for all when the apparatus is known to be in good condition, preferably at the factory, by experts, to give assurance that the specification has been met. Such tests should not be made a second time. After installation, a considerably lesser test should be made upon the apparatus, which will detect any serious injury in transportation and installation. Any moderate deterioration due to absorption of moisture, etc., will right itself with service, provided no abnormal deterioration has occurred. It is preferable to make high-potential tests by increasing the voltage upon the apparatus as it is designed to operate, one terminal at a time remaining grounded, rather than making a high break-down test by voltage from an external source. On tests of very high-tension apparatus, such as generators and transformers, no break-down gap should be used in connection with the determination of voltage. Any error in the voltage of test, provided precautions as to the proper size of testing apparatus are used, will be comparatively unimportant. In some cases the voltage of the testing device may be determined by means of a spark-gap before the apparatus to be tested is connected to the circuit.

In the discussion of the paper of Mr. T. H. Thomas, Mr. Terk was the first speaker. A piece of apparatus is in its weakest condition just after it is installed. During transit it is liable to absorb moisture. While it goes on continually drying out, it improves in quality and will ultimately be in as good a condition as it was when it was tested at the works. But before it has been thoroughly dried out, a strain may occur, and is most likely to occur at this time, as the plant is new and the men are not yet experienced.

Mr. Stott considered the tendency of Mr. Thomas's paper to be to discourage tests and thinks this is not good tendency, as we have no factor of safety to depend upon without an over-potential test. In all structural material for mechanical purposes we insist upon strength and we also insist upon a factor of safety ranging all the way from three to ten. For the same reason cables should be tested at an over-voltage. Concerning the effect of moisture on insulation, he had recently made some tests in an atmosphere of steam at atmospheric pressure; he found that steam had apparently no influence whatever on the surface leakage; the only thing that has any influence is the presence of dirt. The moment dirt of any description is introduced on the surface—such as particles of oil or carbon dust, or anything of that nature floating in the air—the insulation broke down immediately in the presence of the moisture.

Mr. Lincoln said that Mr. Stott's analogy between the testing of mechanical apparatus and the testing of electrical apparatus would hardly hold. In the former case one takes a test piece of the material, puts it into the testing machine and breaks it. Mr. Thomas called attention to the concluding paragraph of his paper in which he does not recommend abolishing high-tension tests, but distinctly recommends them, only urging that they be made with reason.

Mr. Waters recommended testing apparatus at a high voltage for only a few seconds; and when it is installed and is just going into operation, to apply a less severe test, say at 50 per cent. over-voltage. Mr. Skinner said that break-down tests are made first to determine the strength of the insulation and second to determine the workmanship. Every piece of electrical apparatus for any considerable load whatever should receive numerous tests during the process of manufacture to determine this second point.

Mr. Mershon said that a one-minute test at a double potential is not any too severe. In a certain transformer test, a water rheostat caused some mysterious troubles which were avoided after a metallic wire rheostat had been substituted. Tests should be made of apparatus after they have been installed; what is wanted to be known is

the condition of the apparatus at that place, not how it was in the factory.

Mr. Dunn said insulation tests are necessary to see whether the mechanical pressure applied for instance in putting the conductors in the slots, has not damaged the insulation. But no strain above its elastic limit should be applied to an insulation. He urged the collection data concerning the elastic limit of insulation. Mr. A. S. Langsdorf suggested insulation tests analogous to those which are made with metal, and recently with cement, to determine the effect of fatigue, i. e., repeated tests. Mr. H. Pickler called attention to the fact that in tests we sometimes have no sine waves, but a distorted e.m.f. wave highly peaked.

Dr. Perrine referred to the question of the proper subdivision of long lines for their protection from interference. The problem of constructing perfect high-tension switching apparatus is one which must be solved in order to obtain satisfactory long-distance transmission. This problem solved, the multiplication of switching points is feasible and this implies that, with long lines, where two or three duplicate transmission circuits are established, it will become necessary to establish switching sub-stations for no other purpose than the cutting out of sections in the line when repairs become necessary, thus obtaining satisfactory regulation. Such switching apparatus should not be more distant than 25 miles and their location at 15 or 20 miles would be more practical. While the use of automatic switching apparatus would be very advisable, yet the main problem of switching has not been solved so satisfactorily as to permit the consideration of automatic apparatus.

President Scott said that in an electrical machine there are three principal factors: One is iron, which is pretty substantial and determinable from a mechanical standpoint, though it does have its magnetic eccentricities. Then there is the copper which is pretty certain and reliable, both mechanically and electrically. Then there is the insulation, which is a combination of paper, rags and varnish. Now the insulation engineer has a very different and a very difficult problem to handle. With low voltages it is fairly simple. When we get up to the higher voltages, then we have a new order of affairs. One of the things to guard against particularly is that we do not encounter a new kind of phenomena. For example, when we test at two or three times the normal voltage, at high voltages, we are doing this to determine the breaking-down strength. Some phenomena like dielectric hysteresis may come in to make heat, and in suddenly applying the voltages there may be some sudden rises of voltage. It is things of this kind, these incidental and unexpected things, which we must guard against particularly.

Mr. Thomas, in closing the discussion of his paper, repeated his warning that every precaution must be taken to remove intense strains and avoid doing damage where we do not know of it. In a transformer test a spark may occur between two layers inside and the insulation be punctured, and if the apparatus is not in a position to be supplied with current to the full capacity of the system, one may think it is all right; a little later a strain of much less magnitude may come along when conditions are favorable for the fault to be developed and then the apparatus will break down. Concerning fatigue tests, he remarked that time tests are fatigue tests in a sense. A time test with alternating current is the application of recurrent strains and the longer that is carried on the more fatigue tests one has. Concerning the elastic limit of insulating materials, this is a question which he is afraid will never be settled.

There were three communicated discussions of Mr. Thomas's paper, by Mr. L. A. Hawkins, Mr. H. Gerry, Jr., and Dr. Louis Bell.

Mr. Hawkins does not consider of much importance the objection that the weakest point is the only one which is tested; in practice it is the weakest point alone that is of importance. On tests of very high-tension apparatus no spark-gap should be used in connection with the determination of the voltage.

Mr. Gerry recommended more tests of samples of the insulation and less testing under severe strains of the finished product. The effect of temperature on insulating material should be taken into careful consideration. The deposit of moisture during transit may permanently injure the qualities of the insulation. Shipments of such material should be made in hermetically-sealed cases, under oil, or in a manner to prevent contact with moist air at varying temperatures. This is a matter of importance especially in connection with the shipment of large high-tension transformers.

Dr. Louis Bell does not think it wise for a purchaser of apparatus to place much reliance on over-voltage tests set forth in contracts, save in case of line insulators and other simple apparatus. In other cases such tests ought not to be long continued and should not be made until the apparatus has successfully stood a full load test and recovered therefrom. He does not think that a disruptive test is unfair because it may subject to severe strain parts of the insulation which normally receive in commercial working only a moderate strain; the disruptive test ought to try out these very points. He attaches some value to an overload test at a voltage somewhat greater than will ever be demanded in practice, with careful insulation measurements before and after.

In a paper with the title "Choice of Frequency for Very Long Lines," Mr. P. M. Lincoln discussed the question which of the two standard frequencies—60 or 25 cycles per second—is the better frequency for a very long line, if the matter is considered purely as a transmission problem. In his discussion the author assumes a three-phase line 200 miles long. He first takes up voltage regulation and gives a table showing the limits of transmission of low capacities; if the voltage at the receiving end is 20,000, the power which can be delivered with 20 per cent. inductance volts is 500 kw for 60 cycles and 1,250 kw for 25 cycles; for a voltage of 80,000, the power is 8,000 kw, and 20,000 kw for 60 or 25 cycles respectively. If the amount of power to be transmitted is large, the multiplication of lines necessary at 60 cycles unduly increases expense both of pole lines and of right of way for the same; this point is evidently in favor of the lower frequency. The author then discusses the effect of the charging current and shows that in a 60-cycle installation it is necessary either to operate the generators on such a line at about full current output all the time, no matter what the load, or to compensate for the charging current in part or in whole by the installation of choking coils, either horn of which dilemma is not pleasant to consider. The author discusses finally the danger of resonance; the lower the fundamental frequency, the less is this danger. While no actual trouble has ever been experienced in existing plants from this source even in the longest lines and highest frequencies in use, yet it constitutes an advantage for 25 over 60 cycles that cannot be dismissed with a scoff. In spite of these advantages of the lower frequency, it is a fact that the longest transmission line in the world (Bay Counties) and the highest voltage line (Missouri River Power Company) are both operating at 60 cycles.

In the discussion of Mr. Lincoln's paper Mr. Mailloux said that as electrical energy is used mainly for lighting the frequency must be chosen accordingly; he himself has found a frequency of 40 to be unsatisfactory for lighting; he thinks a frequency of 50 might perhaps be a satisfactory compromise.

Mr. Stott said that incandescent lighting becomes impossible at about 20 cycles, as shown by experiments which he carried out. Twenty-five cycles, with a low-efficiency lamp, taking about 4 watts per candle, at voltage of 110, were found quite satisfactory; they made the experiment of having direct-current lighting in the draughting room and then without notice threw it over on the alternating current, and no one knew anything about it. About 30,000 incandescent lamps in the elevated stations in New York are run now on 25 cycles and very few people notice the fluctuation. He thinks it depends a good deal upon the voltage regulation and also upon the fact that low-efficiency lamps are used.

Mr. Mershon said that in most transmission plants the condition to be met first is that of delivering power at a high frequency of 60 cycles. Then the question comes down to whether or not it is better to transmit at 25 cycles and use frequency changers for 60, or whether it is better to transmit at 60 cycles and use synchronous motors to raise the power factor of the load. If one considers the question of the investment in both cases, the 60 cycles show up much more favorably. Concerning the lowest frequency suitable for lighting, the personal element is to be taken into account; the majority of people cannot notice any effect from 30 cycles.

Mr. Rushmore said that with relation to the self-induction and capacity of the line, one must also take into account the apparatus in the circuit. The higher the voltage is which is applied, the more care must be taken that the generator e.m.f. wave should have the form of a sine wave. Messrs. Lincoln, Mershon and Perrine discussed the possibility of obtaining regulation be means of synchronous motors placed at the end of the line. Mr. Lincoln believed that the scheme of Mr. Mershon would not work. Dr. Perrine referred to a successful regulation of a line effected by Mr. Baum by means of an automatically excited synchronous motor.

Mr. Stott referred to experiments made some time ago in Columbia College and which showed that 20 or 21 was about the highest frequency at which any man could detect a flicker of incandescent lamps regularly; in fact, the majority could not detect with certainty a flicker at a frequency of 20. He also referred to a case in which arc lamps are said to have been operated quite satisfactorily at a frequency of 30.

There were presented two communicated discussions of the paper of Mr. Lincoln, the one by Mr. B. A. Behrend, the other by Prof. F. G. Baum.

Mr. Behrend pointed out that in considering the question whether a frequency of 25 or 60 cycles is preferable for power transmission, one should not confine the attention to the line itself, but should take into consideration the generating plant, the transformers, and the sub-station as well. In regard to the generating plant and the transformers, a frequency of 25 is without doubt lower than desirable. In regard to the sub-station apparatus, a frequency of 25 is as high as desirable for rotary converters, while it is too low for lighting.

Prof. Baum also said it is not right to confine the discussion of the choice of frequency to the transmission line, because the frequency effects every part of the system, including generators, transformers and receiving apparatus. If one would take the effect on the transformers alone into account, the higher the frequency, the better. The best frequency for the generators depends on the speed at which they are driven, and on their capacity. If a system were to be laid out entirely new, including receiving apparatus, it is very probable a lower frequency than 60 would be chosen; but if the power is to be used for a mixed load of lights and motors, the frequency would be limited by the periodicity at which the flickering of lamps can be noticed, i. e., about 30 cycles. If the lines are to increase in length to 300 and up to 500 miles, it will be necessary to operate at less than 60 cycles in order to reduce the reactance volts and also on account of coming into resonance with the line.

In a paper entitled "The Operation and Maintenance of High-Tension Underground Systems," Mr. Philip Torchio gave some notes on moderately high-tension underground systems as installed in large cities in the last few years. Concerning independent vs. parallel operation of feeders at sub-stations, he remarked that independent operation has in most cases the disadvantage of not allowing the full use of the copper investment at light loads; but has the following advantages: The short-circuit current fed back from the sub-station bus-bars into a faulty feeder is limited by the reactance of at least two sets of transforming apparatus, which will materially help the final clearing of the short circuit. Further in rotary converter sub-stations the independent groups of transforming apparatus can be fed from different bus-bars or from different generating stations, thereby increasing the reliability of service. The author made some brief remarks on testing of cables and gives in a table the record of all cable faults of a New York company for a period of five years, the voltage of operation being 6,000; of the 9 faults manifested there were 5 due to extraneous mechanical causes and 4 to defective installation.

Ground detectors with annunciator relay and drop-signal are considered as desirable features of a high-tension switchboard equipment. Grounding of the neutral of high-tension generators has apparently given satisfaction wherever it has been tried; the objection to the heavy short-circuit current from one leg to ground has been overcome by the suggestion of grounding through a non-inductive resistance, thereby limiting the short-circuit current to a pre-determined amount. It seems impossible always to guard against the appearance of high voltages due to sudden change of load, grounds, short-circuits, etc., and, especially in the latter case, spark arresters will greatly increase the safety. These devices are preferably connected delta on systems without grounded neutral and installed at the generator end as well as sub-station end of every cable and at every other place where the cable is looped into a sub-station or joins an overhead line.

"The Use of Automatic Means for Disconnecting Disabled Apparatus," was the subject of a paper by Mr. H. G. Scott, in which he gave some notes on this subject, dividing it into three sections: generating apparatus, transmission apparatus, receiving apparatus. He states as a general proposition that no overload device should be used in the generating plant to disconnect disabled apparatus. On each generator a suitable circuit-breaker should be installed which will operate only when the direction of flow of energy through it is reversed. As an additional precaution in large plants, a second reverse-current relay should be installed which will merely light up a letter or number in front of the operator so that in the event of the failure of the first automatic device the faulty machine may be quickly disconnected by hand. These reverse-current relays should have a time element and current-limit attachment, which should be set for not less than three seconds, so that a slight reverse current, or one of momentary duration, such as is liable to occur at the moment of multiplying, will not operate the circuit-breaker.

For transmission lines the author recommends to run the feeders entirely separate at the receiving end, only putting the direct-current end of rotaries in multiple; or in cases when low-tension alternating current (2,000 volts or less) is supplied, putting the secondaries in multiple. If under these conditions, reverse-current relays are installed at the receiving end of the feeders they will operate very satisfactorily as the reactance of the rotaries and transformers will be sufficient to limit the reverse current in the faulty cable, thus allowing the reverse-current relays to operate, as there has been no serious fall of potential. The greater the number of feeders between the generating station and the sub-station, the better this method becomes.

With the title "Electric Cables for High-Voltage Service," Mr. Henry W. Fisher gave some notes on the manufacture of cables. Since paper-insulated cables have been improved, some engineers prefer paper to rubber, the life of paper cables being assumed to be longer than that of rubber cables. On the other hand, the ability of a rubber-insulated cable to withstand high voltages depends upon the ingredients entering into the composition of the rubber compound. The dielectric strength to resist electric pressure becomes greater within certain limits with increased percentages of pure Para or other high-grade rubber, and there is good reason for believing that when lead-covered cables are employed the life of rubber-insulated cables is lengthened with increased percentages of such rubber. In the manufacture of paper-insulated cables for high voltages, great care has to be exercised in selecting the right kind and quality of material, and also in the methods of construction and impregnation of the paper with the insulating compound. Cables saturated with oily compound can better be handled without injury to the dielectric, and also resist better high voltages. The use of oily compound is, however, accompanied with lower insulation resistance, and consequently many engineers who think they are adopting the best practice by specifying several hundred megohms per mile, are in reality inviting bids on an undesirable type of cable.

The carrying capacity of cables as frequently recommended is entirely too great when many cables are in the same duct system. In this case the middle and top one, although carrying normal currents, are apt to become very warm. Under no circumstances should the temperature of the conductor be allowed to reach 90° C.

The three papers by Messrs. Fisher, Torchio and Stott were discussed together. Mr. W. C. Carlton contributed a written discussion of Mr. Torchio's paper. The experience of the Chicago Edison Co. with its high tension three phase cables has been similar to that of the New York Company, mentioned by Mr. Torchio. At present they are operating about 45 miles of three-conductor cable at 9,000 volts. The first of these cables was installed about five years ago. The voltage used at first was 4,500, but about a year and a half ago it was changed to 9,000. There have been seven cases of trouble on these cables; four were caused by mechanical injuries to cables in manholes; one by a burn out on an adjacent cable; one by a defective joint and one by electrolysis causing a hole to be made in the lead sheath of the cable. With the exception of the defective joint, none of these troubles would have been avoided by using high pressure tests in the cables. The neutral points of the high tension generators are grounded direct, no resistance being used to limit the flow of current. Two of the cases of trouble, one due to mechanical injury and one to electrolysis, resulted in one conductor of the cable burning to ground, the other two being left in good condition. Very little damage was done, but he believes that if they had been operating without a grounded neutral, the chance would have been greater for more serious trouble, owing to the displacement of the neutral that would have occurred.

Mr. W. P. Wells contributed a written discussion of Mr. Stott's paper. He states that his recent experience with 6,600-volt, revolving-field apparatus in central station practice, has convinced him that automatic disconnecting devices are not necessary in order to insure reliable operation of the system to which current is supplied, and that capable operators with good judgment can handle any

cases that may arise. During the two years that his station has been in operation it has always been the practice to run the high-tension feeders on what Mr. Stott refers to as the safest plan, i. e., entirely separate at the receiving end, only putting the direct-current ends of the rotaries in multiple. But as practically all the sub-stations are equipped with large storage batteries, which are also in multiple with the rotaries, it has been found best to operate without reverse-current relays, but depend on the operator in the sub-station opening the circuit-breakers when necessary. On the entire system there are in use no automatic disconnecting devices except those operated by time overload relays on the feeders in the generating station and by a centrifugal speed limit device on the rotaries in the sub-station.

In the oral discussion which folowed, Mr. Schwartz was the first speaker. He agreed in general with Mr. Stott and made some remarks on the reverse current relay for the generator circuit. For the transmission line he thinks that at the generator an overload relay with a time limit device will be generally sufficient.

Mr. Eglin said that with the growth of the size of generating stations and with all the feeders run in parallel on a large generating station, some means must be provided for limiting the amount of energy that can be put into any short circuit of a high tension cable. Their practice has been to subdivide the feeders at the sub-stations these not being tied together there. Their operation has been very successful.

Mr. Mailloux said that in many cases automatic devices are undesirable, and referred to the experience which he had with isolated plants in large hotels, where they depend on the operators entirely; the principle thing in such a hotel is to avoid a panic.

Mr. Mershon, and Mr. Mailloux asked several questions to which Mr. Wells replied. It is the practice of the New York Company, mentioned in Mr. Torchio's paper, not to make any over-voltage tests on cables or, in fact, on any electrical apparatus. Cables and apparatus are thoroughly tested before being put into service. A test of a light over-voltage, of 20 or 30 per cent. is enough to determine whether the work has been properly done or not.

Mr. Stott said that it is the practice of his company to make a 30-minute test at 100 per cent. over-voltage. They have found that a joint which is comparatively poor will stand up as long as 18 minutes and then break down. They have in operation over 120 miles of 11,000-volt three-phase underground cable. Out of that 120 miles they have had only one fault in the cable itself. All the others were due to inferior work in the joints. Since they went into operation 20 months ago, they have had a total of four break-downs while operating. He believes that a great deal of the underground troubles which have occurred were not due to faults in the insulation, but to faults in the lead sheath, stray currents from other properties passing through the same. They have now decided to re-insulate the lead sheaths of their cables all the way through in the man holes. The condults are very good insulators themseves.

Mr. Fisher gave an account of cable tests recently made at Niagara Falls. He stated that cables are now working at 22,000 volts in this country, being guaranteed for that voltage. A communicated discussion by Mr. E. P . Burch dealt with the very successful operation of two 12,000-volt, three-phase cables, of 9.5 and 7 miles length respectively, in Minneapolis. Most cable faults are due either to mechanical injuries or to chemical deterioration of the sheath from electrolysis; in both cases moisture finally works through the paper insulation. Mr. R. S. Kelsch contributed a written discussion on the use of automatic means for disconnecting disabled apparatus. Reverse current relays should be set to operate at 5 per cent. reverse current.

Recent Electrochemical Developments.

REMOVING SILICA FROM COKE.

In the manufacture of aluminum and other metals by electrolytic processes, the carbon used in the electrodes must be free from silicon compounds and particularly silica; otherwise when the electrodes are consumed in operation, the silica originally contained in the same is taken up by the aluminum, thus yielding an impure product. In order to avoid this, it has been proposed to use in the electrodes petroleum-coke, because it is practically free from silicon, but such coke is more expensive. Mr. Charles M. Hall, the inventor of the Hall aluminum process, has now devised a method which has just been patented to him, for removing silica from the ordinary and cheaper kinds of coke.

This method consists in mixing with the pulverized coke a metallic fluoride which will react with the silica, giving a fluoride of silicon, which goes off as a gas during the process of baking the electrodes. Sodium fluoride, cryolite and fluorspar give good results. The powdered coke and fluoride is then mixed with pitch or an other suitable binder and formed into blocks or whatever form of carbon is desired.

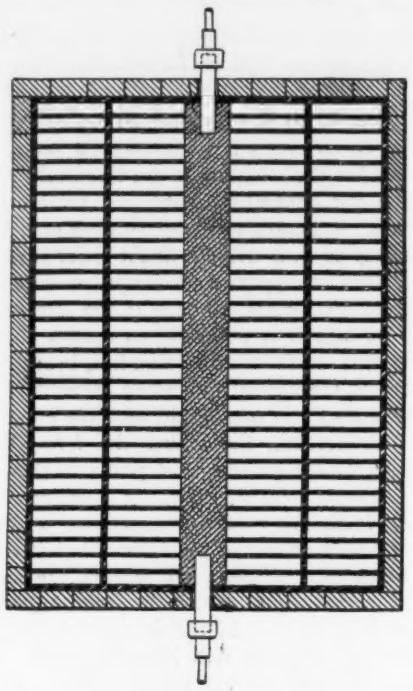


FIG. I.—REMOVING SILICA FROM COKE.

These are then baked in a furnace of the form shown in the adjoining diagram. The wall of the furnace is built of brick, and in it the carbon blocks are placed, insulated from each other. In the center of the furnace a core of a suitable material is provided which can be heated to an adjustable temperature by means of an alternating current supplied through the binding posts, indicated at the top and the bottom of the figure. The temperature should be somewhat higher than in the ordinary baking furnace, in order to facilitate the chemical reaction between the fluoride and the silicon.

Instead of mixing the coke, fluoride and pitch and forming them into the desired shape before baking, thereby combining in one process both the purification of the coke and the manufacture of the electrodes therefrom, the purifying step may be carried out separately by heating the mixture of coke and fluoride alone. The operation of the process in two steps has one advantage; namely, that the material then receives two heatings, thus insuring the completion of the desired chemical reaction.

ANODES FOR ELECTROPLATING.

A patent was granted on July 14 to Mr. Harry E. Starrett, of Chicago, for the use of metallic (especially nickel) anodes of elliptic cross-section instead of the usual rectangular form. Flat anodes of rectangular cross-section are corroded and dissolved more readily at their edges and corners than at other places on their surface, and cathodes suspended opposite such anodes receive the deposits of the metal of the bath more rapidly at those points which are nearest the edges and corners of the anodes, thus producing a coating of unequal thickness.

A recent investigation by Prof. C. F. Burgess and Carl Hambuechen (published in *Electrochemical Industry,* June) gives point to this patent. They determined the variation of the current density over the various places of the anode surface, with electrodes of oval and of rectangular cross-section, and found that it is quite constant over the whole surface in the former case, but not in the latter. This has the effect that with an oval electrode, the corrosion takes place in such a manner that the electrode retains its original shape, although, of course, decreasing in size, the corrosion continuing until the electrode is reduced to a very thin rod or slip; the necessary waste or scrap from such electrodes is, therefore, only 5 per cent., against about 15 per cent. with electrodes of rectangular cross-section.

OZONIZING APPARATUS.

The construction of ozonizing apparatus for the sterilization of water has been undertaken with considerable energy by various elec-

trochemical inventors in Europe, and apparatus of various types are operated on a commercial scale in different cities of Germany and Holland. A patent, granted on July 14 to Dr. Marius Otto, of Paris, France, is especially interesting at the present time in view of the fact that an exhibition of his ozonizing and sterilizing apparatus was recently given in Niagara Falls. The feature of the present patent is the method by which the cooling of the glass plates and the insulation in the ozonizer is effected.

The adjoining diagram shows the Otto ozonizer, in which a sheet of iron, *a*, provided at its upper end with an air chamber, *b*, and an exhaust pipe, *c*, is suspended between two plates of glass, *d*, held at a suitable distance by insulating clamps made of glass. To the exterior surface of each of these two plates of glass is fixed a metallic conducting surface, *e*, covered with a layer of felt, *f*. The whole arrangement is firmly secured by screws to the metallic support, *g*. Two perforated metal tubes, *h* and *i*, allow of the felt layers, *f*, being continuously sprinkled with water. The two exterior electrodes are connected to earth at *t*. Only the metallic sheet, *a*, is insulated and is connected by means of the wire, *l*, with one pole of the high-tension winding of a transformer, *m*, the other pole of which is connected to earth. When the apparatus is in working order the electric sparks leap the interval between the sheet, *a*, and the interior surface of the dielectric, *d*. Air flowing in the direction indicated by the

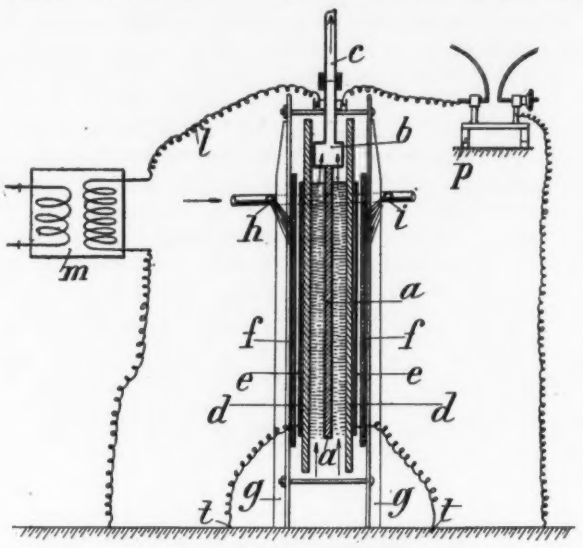


FIG. 2.—OTTO ATOMIZER.

arrows intersects these sparks and is thus ozonized, to be led to the sterilization tower. *P* is a spark-gap, to act as an automatic protecting device should the potential reach a limit dangerous to the security of the apparatus.

REDUCTION OF METALS IN THE ELECTRIC FURNACE.

A patent, granted to Mr. Georg Egly, of Charlottenburg, Germany, refers to a well-known difficulty experienced in the reduction of metals in the electrical furnace, especially in the preparation of nickel by reduction of protoxide of nickel in presence of carbon. This difficulty is that the molten metal easily takes up carbon from the electrodes, thereby appreciably diminishing the value of the product. Mr. Acheson, in a recent patent, avoids this difficulty in an electric furnace heated by means of core of carbon, by covering the carbon core with a refractory heat-conducting sheath of a carbide.

The furnace has two electrodes, and the lower horizontal one, which in the case of continuous current is the cathode, is covered with a layer of about 2 cm thickness, of a scoria which protects the metal formed in the reduction process against the absorption of carbon from the lower electrode. This scoria is formed over the lower electrode previous to the reduction process, and magnesia is said to be a substance especially well fitted for the formation of such a coria.

Wireless Telegraphy in Guadaloupe.

Consul Ayme, of Guadaloupe, reports on June 10 that the wireless telegraph system in operation between that island and Martinique has been thrown open to the public. Messages are transmitted to the station at Gosier by telephone. The tariff of rates is practically that of the French Cable Company, the lines of which were broken at the time of the eruption of Mont Pelée, and have not yet been repaired.

New Telephone Patents.

REDUCTION OF SIDE TONE.

With common battery systems the production of an ideal talking circuit for sub-station instruments has been a considerable problem. Both clearness and volume are obtainable in many ways, but their accomplishment has involved a volume of side tone such as to bring the resultant efficiency below the desirable limits. An improvement in the standard circuit of the Bell Company, having for its object a reduction of side tone, is the subject of a patent recently granted to A. B. Stetson.

In the Bell Company's standard circuit the transmitter is inserted in that portion of the circuit numbered 8, 9 in Fig. 1. The present

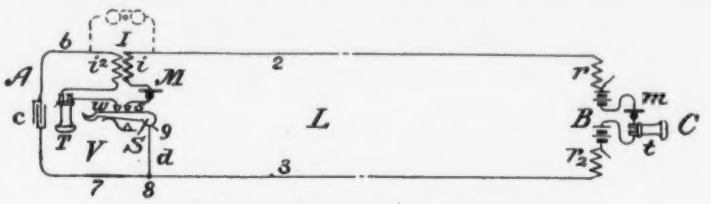


FIG. 1.—STETSON SUB-STATION TELEPHONE CIRCUIT.

invention consists in transferring it to the position shown, isolated from the local receiver circuit. This change eliminates from the receiver circuit any "series" or direct effect from the transmitter, and it has been found to materially reduce the side tone. On the other hand, the change in the circuit is evidently such as to have little effect upon its transmitting and receiving qualities.

ANTISEPTIC DEVICE.

After a considerable period of quiet the antiseptic mouthpiece has again broken forth, appearing in a patent granted to S. J. Ballard, of Los Angeles, Cal. This device is of the "sheet of paper" type and is adaptable to both receiver and transmitter. A rather neat metal clamping device holds a pad of paper sheets near the mouthpiece of the instrument in a position such that a single sheet may be conveniently inserted between the mouthpiece and the user. It is suggested that such paper sheets be used for advertising as well as for antiseptic purposes. The chief merits of the device lie in its simplicity.

NEW EXCHANGE APPARATUS.

In Fig. 2 is shown in detail the magnet and coils of a receiver which has been patented by Mr. J. S. Goldberg and assigned to the Stromberg-Carlson Company. The object in view is the production

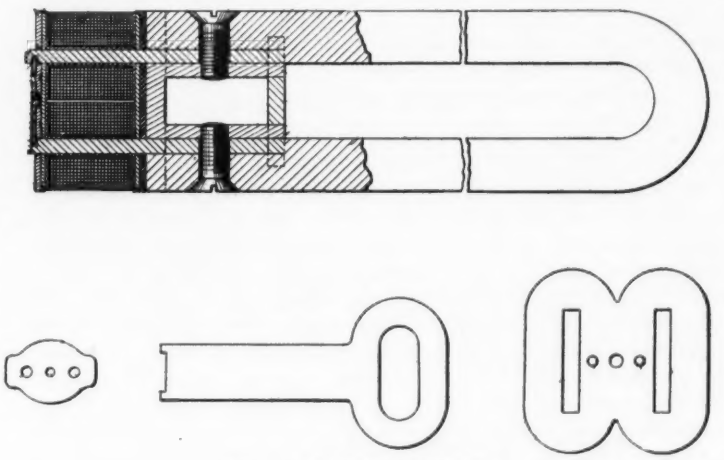


FIG. 2.—GOLDBERG RECEIVER.

of a receiver which can be disassembled quickly and easily, and the inventor seems to have succeeded excellently in accomplishing this result. The mounting of the pole pieces and pole spacer are self-evident, but this is scarcely true of the coil retainer, which is arranged as follows: After the coils are slipped upon the pole pieces, a punched metal washer, shown in plan at the left of the figure, is slipped down above them. Over the retaining washer the clamping plate is placed. This plate is shown at the right of the figure. The clamping plate has a central projection which registers with the small central hole in the retaining washer and serves as a pivot. By the aid of the spanner wrench, the ears of the clamping plate are turned into slots in the poles. In this position the plate becomes locked,

because the wrench holes drop over light projections rising from the retaining washer. It is claimed that with this construction, which is not expensive, receiver coils may be replaced at subscribers' premises in a very few minutes.

A circuit switch of the type commonly used with the hand microphone of foreign practice has been applied to receivers by Mr. Benj. O. Fox, of Milwaukee. The side of the receiver body is slotted to receive the switch piece of hard rubber, as shown in Fig. 3. This handle is mounted directly upon the swinging switch member, which projects into the cup-shaped end of the receiver and swings between the other contact springs. These springs are bent to clear the receiver coils and magnet.

A second circuit switch, this of the ordinary hook variety, has been patented by E. H. Strauss, of Chicago. In this switch the contact springs are arranged beneath the switch lever and are assembled in groups after the manner of switchboard keys. Rubber projections from the switch lever engage the upper springs and thereby control the contacts.

Mr. J. S. Gemmill, of Cleveland, Ohio, has designed and patented a new call bell ringer in which the distance between the armature and the polarizing magnet is kept constant. Adjustment is accomplished by providing the operating magnet cores with slidable centers. These may be adjusted to alter the air-gap, without changing the position of the armature.

COMBINED JACK AND DROP.

Combined jacks and drops have received a good deal of attention from the independent manufacturers, many different kinds having been produced. The latest of these is described in a patent granted

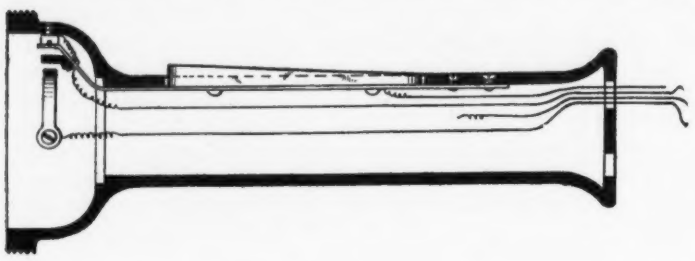


FIG. 3.—FOX TELEPHONE.

to Charles E. Egan. In this the jack is placed directly in front of the drop to economize space. The drop shutter is perforated to clear the jack body sufficiently to allow of its falling just far enough to display a satisfactory signal. Self-restoring features are contemplated, but these and the details of construction are not disclosed in the present patent. Mr. Egan has assigned his patent to the Western Telephone Manufacturing Company.

AN AUTOMATIC CENTRAL OFFICE.

A new automatic exchange system of German origin forms the basis of a patent issued to Friedrick Merk, of Berlin. This system provides a selector switch at the subscriber station and a switching machine for each line at the central office. The apparatus at the subscribers' station is remarkably simple, requiring but one extra electrical contact, and but one electromagnet, this controlling an escapement. The central switches are also fairly simple, this simplicity being made possible by the use of a continuously rotating commutator. One commutator performs the current switching functions for the whole exchange, its various brushes being connected to eight bus-bars, which tap all the switching machines. The commutator carries four independent rings connected to batteries and thus continuously sends out upon the associated bus-bars the sequence of current impulses necessary for completing a connection. It thus only remains for the sub-station selector switch to start its central office connecting switch and to stop it, all intermediate switching functions automatically taking place through the agency of the commutator.

The connecting switch arm passes over a series of contacts to which the several lines are connected in the proper sequence, the number of steps made by the switch arm determining the particular line with which connection is established. Provision is cleverly made to prevent interference with busy lines, to automatically send all signals and to restore all parts to the zero position upon the return of the receivers to the switch hooks. The apparatus in its present form is unfortunately adapted for a few lines only, but the ideas involved seem worthy of further development.

CURRENT NEWS AND NOTES.

TELEGRAPHERS' UNION.—The Commercial Telegraphers' Union of America is now holding in New York its first annual convention. Delegates are in attendance from Philadelphia, Chicago, Boston, St. Louis and other large cities, and several from Canada.

LIGHTNING IN A COAL MINE.—During a thunder storm at Frackville, Pa., July 15, a lightning bolt descended into a mine, following the steel rails into the slope to the bottom, a distance of about 400 ft. Several miners received shocks, but none was seriously injured.

TELEGRAMS ABOUT THE POPE.—Some idea as to the immense amount of telegraphic traffic caused by the illness of His Holiness, the Pope, may be found from the following cable dispatch from Rome, of July 15: "Yesterday the number of dispatches inquiring about the Pope's condition which have been received at the Vatican reached 26,000, including some lengthy cablegrams from half round the world. The total cost of these telegrams is estimated at $36,000. This enormous deluge taxes to the utmost the resources of the Vatican administration. A large force of priests and seminarians is temporarily aiding the officials in making responses, which bear the signature of Cardinal Rampolla." This, of course, is wholly exclusive of the enormous quantity of cable news and special cable correspondence from all parts of the world.

INSULATION FOR HIGH-TENSION CURRENTS.—A patent was granted on June 30 to M. K. S. Lemström, of Helsingfors, Finland, for an insulator for use in connection with influence machines generating high-tension current, and in which it is desirable to provide against the loss of any portion of the current. A porcelain insulator of the ordinary bell form is employed, but is not fastened to an iron support, as is usually done, but to the upper end of a vertical rod of highly polished ebonite. If the surface of the porcelain bell should get moistened, the current which might escape by way of it, is interrupted by the ebonite support, to the polished surface of which water does not adhere. On the other hand, the porcelain bell protects the ebonite from the deteriorating effects which are usually caused in the polish of ebonite by exposure to the weather.

TESLA AT WARDENCLIFFE.—Some startling things have been taking place at Wardencliffe, L. I., according to a press dispatch from that place. The dispatch reports that "all sorts of lightning were flashed from the tall towers and poles" in the grounds where Mr. Tesla is at work. It is understood that Mr. Tesla has driven a deep well beneath the tower and that the electric waves are sent underground as well as through the air. "It is true," Mr. Tesla is reported to have said, "that some of them (the experiments) have had to do with wireless telegraphy, and that in addition to the tower and poles there is a hole dug in the ground. This is 150 ft. deep and is used in these experiments. If the people about there had been awake instead of asleep, at times they would have seen even stranger things. Some day, but not at this time, I shall make an announcement of something that I never once dreamed of."

NEWS ALL THE VOYAGE.—The Cunarder *Campania*, on her arrival last week, attested a remarkable development of Marconi wireless telegraphy at sea. She was never "out of touch" the whole way over and back. By her log it is shown that going to the eastward she held converse with the Marconi wireless stations at Babylon, Sagaponack, steamship *Umbria* coming west, and Nantucket Lightship. These dialogues were on a Saturday. Sunday the Atlantic Transport steamship *Minnetonka*, proceeding for London, was the link; Tuesday the sister ship *Carpathia*, from Liverpool, bound this way; Tuesday and Wednesday the *Lucania* and the *New York* were picked up; Thursday the Cunarder *Ivernia*, bound for Boston; Friday and until the stage was reached at Liverpool, *Crookhaven, Rosslare, Holyhead, Seaforth* and the *Etruria*, leaving port. Returning this way the *Saxonia*, a Boston Cunarder, *Seaforth, Holyhead* and the *Umbria* were "on the wire." Sunday *Rosslare, Roche's Point* and *Crookhaven;* Monday the *Carpathia*, steaming in the other direction, was on the list of correspondents; Tuesday and Wednesday the *Lucania* was the connecting link; Thursday the *Philadelphia*, also steering eastward, and Friday and until arrived at her

pier Saturday, the *Campania* talked with Nantucket Lightship, Sagaponack, Babylon and the *Etruria* in the North River about to sail for home. The *Cunard Bulletin*, published Friday, July 17, had the news transmitted through the air from Nantucket Lightship of the Pope's condition; the death, in London, of William E. Henley, the author; the execution of Dougal, the Moat House murderer, and confession on the scaffold; the death of Mrs. James G. Blaine; the record of the Great Western Railway train from London to Plymouth, which covered 246 miles in 233¾ minutes; entertainment of the American fleet at Portsmouth; the government crop report, and market reports.

WIRELESS TELEGRAPHY IN THE NAVY.—Rear Admiral Bradford has ordered twenty sets of wireless telegraphy for installation on the flagships and scouts which will participate in the summer manœuvres. The *Topeka* and *Prairie* will soon install wireless telegraphy sets for experimental purposes.

PAPAL CANDIDATURE.—The Marquis de Castellane, discussing in a New York newspaper the prospects of the various candidates to succeed Leo XIII, says of one of them: "Cardinal Ferrari, Archbishop of Milan, is not favored, for the apparently trivial reason that he uses a motor car, which is not considered dignified in a Prince of the Church."

TELEGRAPHS IN EAST AFRICA.—The telegraph system in the East African British Protectorate of Uganda now extends to the shore of the Albert Nyanza. The trunk line from Mombasa, with its branches, is over 1,034 miles in length, and the charge over the whole distance is 4 cents a word, with a minimum of 33 cents for a message of eight words. There is also a telephone service along the whole distance, which may be used at 33 cents a conversation. The pole line consists of living trees.

NOTABLE ITALIAN STORM.—A fierce electrical display occurred recently in Northern Italy and residents near Lake Como were treated to an extraordinary exhibition of lightning pyrotechnics. Thunderbolts fell in every direction, and the ground seemed to shake from the terrific roar of the thunderclaps. One thunderbolt fell into a cabin where ten peasants and a dog had sought shelter. Five of the peasants and the dog were killed outright. It is said, however, that some one had presence of mind enough to secure some good photographs, which will be very interesting.

NEW RUBBER SUPPLY.—In a report to the Department of Commerce and Labor Consul-General Guenther says that a Liverpool firm, which does a large trade with West and Southwest Africa, recently received a species of plant, hitherto unknown, that produces rubber. The plant grows underground and will probably be found in English West Africa. The rubber is directly beneath the bark and is of unsurpassed quality. Ordinarily the roots, when about one month old, contain from six to six and one-half per cent. of rubber. If the bark is removed the percentage is higher.

EXTENSION OF PACIFIC CABLE.—It is now stated from San Francisco that the Pacific Commercial Cable Company will proceed immediately with its cable from Manila to Shanghai. R. Lucas, the engineer who has charge of the laying of the cable from Honolulu to Manila, has arrived there. In discussing the project, Mr. Lucas said: "The cable undoubtedly will be extended from Manila to China, for such was the intention when I left England to begin the work of connecting Honolulu with Manila. The port of Shanghai has been selected by the company as a terminus of the wire. The steamers *Anglia* and *Colonia* will return home, and one will then be sent out with the cable, which is to connect Manila and Shanghai."

NEW INVENTIONS OF MARCONI.—The London correspondent of a Montreal paper announces that new inventions have been made by Mr. Marconi which will greatly facilitate the transmission and reception of long-distance wireless telegraph messages. It is stated that Mr. Marconi is expected to arrive on this side about the middle of August, when the new system will be placed in operation at Table Head and Wellfleet. It is reported that these inventions are of a very radical and revolutionary character. According to the statement of a gentleman authorized to speak for the American Marconi Company, poles and towers for use in the transmission of transatlantic messages will be unnecessary, the entire operation being conducted at the sea level. Further than this, it is stated, instruments have been devised which wholly neutralize the effect of atmospheric electrical disturbances upon the apparatus used in wireless telegraphy. Syntonism, this gentleman further states, has advanced beyond the experimental stage and has entered the realm of practical certainty.

A CURIOUS THIRD-RAIL DISPUTE is exhibited in the following item from Scranton, Pa.: "Grand Master Morrissey, of the Brotherhood of Railroad Trainmen, telegraphed the local lodge of the Brotherhood to accept the application of the employees of the Laurel Line, a third-rail electric road, for membership in the brotherhood, despite the protest of the Amalgamated Association of Street and Electrical Railroad employees, that these men come under its jurisdiction. A boycott was placed on the road when it was opened in May because the employees were not unionized. The company declared its willingness to have the men join a union and the men made application for membership in the brotherhood. National Organizer W. B. Fitzgerald, of the Amalgamated Association, declares that unless the men join his organization the boycott will not be lifted. The fight is the opening of what promises to be a bitter war between these two organizations for jurisdiction over the employees of this new kind of railroad, a line which is operated and disciplined the same as a steam railroad and runs over a private right of way between distant places, but which uses electricity for motive power."

SPEEDY DEEP SEA CABLE LAYING.—In speaking of the recent work of the *Anglia* in laying the Commercial Pacific Cable, the Honolulu correspondent of the *New York Herald* says: "In the actual work of laying the final section of cable the *Anglia* had a very remarkable trip. She started soon after noon on June 26 to pay out the section from Midway to Honolulu, and came right along without the slightest hitch or delay, taking the courses surveyed by the *Hero* several years ago. The deep sea cable ended about ten miles south of the Island of Oahu, about eighteen miles from the place where the shore end was landed. The *Anglia* laid exactly 1,315 knots of cable from Midway to this point, and with the additional eighteen miles of shore end the actual amount of cable laid is 1,333 knots. There was about eight per cent. of slackage. The cable force was very proud of the making of a new record for continuous use of the wire log, which registers the distance traveled. This log is on reels of 140 knots each, which have to be renewed as fast as they are run off. Heretofore the transfer of the reels has necessitated vessels slacking. The greatest run ever made before without a stop was 840 knots. The *Anglia* ran the entire distance of 1,221 miles without a single break or stoppage or slacking of speed. The greatest depth encountered on the trip from Midway was about twenty-seven hundred fathoms."

TROLLEYS AND AESTHETICS.—With regard to trolley extension in Paris it is stated that the controversy over the matter has brought out many harsh criticisms about the way the authorities are gradually but surely "uglifying" *la ville lumière*. One interview in the *Figaro* which has attracted considerable attention is with Victor Binet, the well-known decorator. He asks what is the use of bothering with overhead wires—for trolleys must be endured whether they are ugly or not—when so many other misdeeds against art are being committed. The so-called new art has so stultified the public that no trace of taste remains in France. These new art people have been working for years to make Paris ugly. They were allowed to devastate the Esplanade des Invalides and the Champs d'Elysées. The new monuments and ornaments in the squares and parks are ridiculous—gingerbread and cardboard monstrosities altogether devoid of decorative effect. The new houses are hideous with their absurdly unornamental facades, which will harmonize well with the trolley wires, the gibbets stuck all over the city, and the yellow asparagus stalks fixed up over the entrances to the stations of the underground railway, called for brevity the "Metro." "Let us pray," says M. Binet, "for power to stand all this mercantileism, Americanism and utter ugliness." But why "Americanism"? New art is decidedly a European production, French or German, perhaps both.

INTERNATIONAL EXPOSITION AT MILAN.—The completion of the Simplon tunnel will be marked by an international exposition, to be held in Milan in 1905. A fund of $600,000 has already been raised, half of which was contributed unconditionally.

TO STUDY AMERICAN TRANSPORTATION SYSTEMS.—According to a London dispatch dated July 15, the Royal Commission which was appointed to examine into the question of London street traffic has decided to send a sub-committee to the United States in the fall to study American systems of transportation. Mr. H. H. Vreeland, president of the Interborough Rapid Transit Company, New York, is now in Europe and will appear by special request before the Royal Commission in London.

RIOT OVER TELEPHONE FACTORY STRIKE.—Riots and disturbances continue to result from the strike of workmen employed in the factory of the Kellogg Switchboard & Supply Company, of Chicago. In our issue last week reference was made to the strike and some acts of violence committed. The lawlessness has attained such proportions that Mayor Harrison issued a proclamation on July 17 warning all persons from lounging or gathering together at any place within the city where there is disturbance or riotous conduct of any persons. The business of the Kellogg Company has been conducted under police protection. A squad of police was attacked on July 17, but quickly scattered the mob. Judge Holcom's injunction restricting the picketing of the Kellogg factory has been upheld by the Appellate Court.

WIRELESS TELEGRAPHY IN THE AMERICAN NAVY.—Information comes from Washington to the effect that the Slaby-Arco system of wireless telegraphy will probably be adopted for use on the American warships. Experiments have been conducted for over a year by the Bureau of Equipment to determine the best system of wireless telegraphy for use, and, according to the dispatch, it is a foregone conclusion that the officers in charge of the tests will select the Slaby-Arco system. It is stated that twenty sets of Slaby-Arco instruments have arrived from Germany. These will be installed on the battleships *Kearsarge, Illinois, Maine* and *Texas;* the cruisers *Olympia* and *Baltimore,* and the training ships *Topeka* and *Prairie.* It is also stated that wireless telegraph shore stations will be established at Cape Elizabeth, Me.; Cape Ann and Cape Cod, Mass.; Montauk Point, L. I.; Newport, R. I., and the Atlantic Highlands, N. J.

LETTER TO THE EDITORS.

Steam Turbines.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the various articles recently published in your paper on the subject of the Curtis steam turbine, and especially that by Mr. W. L. R. Emmet, in your issue of April 11, from which the following is extracted: "All improvements in prime-movers are of great importance to the engineering world. The steam turbine is destined to effect the first really great improvement since the days of Watt, and the forms of Curtis turbine here described make the first great stride in advance of other steam engines."

Now, it is very easy to make such a statement, but I have vainly tried—as regards at least the second part of the above passage—to find out how it could be proved to be correct. If the steam turbines of De Laval and Parsons had not been in existence before the Curtis turbine appeared, or even if I were not acquainted with the fact that Parsons turbines of larger size have been built than the holders of Curtis's rights appear to contemplate building now, I would have nothing further to say; but as it is, the writer of the article in question will allow me to state that I do not agree with him.

Speaking of the Laval and Parsons turbines, the author of the articles continues as follows:

"Both of these turbines have attained some (!) success, but neither as thus far developed affords sufficient advantages over the steam engine to cause any very rapid or radical change in engineering conditions."

He generously admits that the predecessors of the Curtis turbine have had "some" success. That is something. But as regards the second half of the sentence, I again beg to differ. On the European continent, at any rate, the steam turbine has already—that is, before the appearance of the Curtis turbine—caused quite a revolution "in engineering conditions," and it is this very fact to which the Curtis turbine no doubt owes its acceptance as a power generator.

But the Curtis turbine, it will be objected, is an improvement on the Parsons system. Of course, the author of the article, at any rate, thinks so, since he claims that the Curtis turbine has the advantage of *"lower speed, less weight, fewer and simpler parts, higher economy, less cost and other important advantages."* Permit me to make these claims the basis of a short comparison between the Curtis and Parsons turbines, and I will endeavor to show how far they go. I take the Parsons system, because I am better acquainted with it, and also because it is the only one of which large sets are now running.

First, as regards speed: If this word were replaced by number of revolutions, then the Curtis turbine might be said to run at lower speeds, provided the data published by the manufacturers can be relied upon. But it must be observed that the aspect of the case changes entirely if you compare the two systems on the basis of circumferential speed of the blades, which in the Curtis turbine is double and treble the *highest,* or about six times the *average* circumferential speed of the blades of the Parsons turbine. If the lower number of revolutions can only be attained at the cost of such a startling difference in the circumferential speed, then I fail to see where the advantage of a reduced number of revolutions lies.

Second, as to weight and cost, no data are published with reference to the Curtis turbine, and I am unable, therefore, to make an exact comparison of figures. Taking, however, the average dimensions of Parsons turbines and those stated for the Curtis system, I think that the Curtis turbine can hardly be lighter and less costly than the Parsons.

Third, fewer and simpler parts are the next advantages claimed for the Curtis turbine. If it were called more complicated, I would at once endorse the author's statement. Let us compare the rotating part of a Parsons with that of a Curtis turbine. It will be found that a simpler device than the former cannot well be imagined. It consists of a shaft or hollow drum carrying the blades, which are fixed to the drum by the simplest of means, and ample clearance is provided both axially and radially. The Curtis rotating part, on the other hand, consists of two or more complicated wheels with blades cut out of the solid, and the axial clearance, i. e., the clearance between running and fixed blades is, according to diameter, only 0.03 to 0.05 in., which any practical man would condemn. As another instance of the paucity of parts, the governing of the Curtis turbine appears to be entrusted to a very complicated and elaborate device, which will in practice prove proportionally unreliable, whereas the Parsons governing gear, consisting mainly of a single valve, is the very pattern of simplicity.

Fourth, as regards economy, the consumption curves given for the 600-kw Curtis turbine are very good indeed, but the same results can be attained with the Parsons. The figures given for steam consumption of large sets, especially at full load, are, on the other hand, poor, and for big units, unless these figures can be greatly improved upon, I consider the Curtis turbine to be a decided step backward. In fact, the consumptions given are 20 to 30 per cent. inferior to those attained with the Parsons system under same conditions.

Finally, as to other important advantages: I presume that by these is meant that the Curtis turbine is a vertical shaft turbine. The idea of arranging steam turbines with vertical shafts is quite an old one, but has not hitherto been resorted to by competent engineers because of the many disadvantages involved. If we consider that with the vertical turbine the floor space is not less than with the horizontal one, owing to the space that has to be provided for the condensers, which can be placed entirely underneath the horizontal turbine; that the height to the crane of the engine room is the same as for large vertical engines, as against a height of 10 ft. for the largest horizontal units; that all repairs to the internal parts of the turbine other than to minor parts arranged for detachment through lateral openings, necessitate the dismantling of the set one asks—Where are the advantages of this much-prized vertical arrangement?

The horizontal arrangement allows the dismantling of any part without affecting the whole, and the attendance is obviously simplified and made more efficient by being restricted to one plane, and avoiding the necessity of climbing all over the machine.

The present practice in modern electrical and hydraulical engineering bears out the above, for although till quite recently vertical water turbines coupled direct with dynamos were used on an extensive scale, the horizontal arrangement is now being largely reverted to again, the vertical arrangement becoming obsolete.

It is with reluctance that I have taken up the pen to write the above, but I noticed with surprise that no one else tried to reduce to the limits of reality the somewhat exaggerated statements made in the article referred to. Being intimately connected with the steam turbine business, I thought it but right to establish the facts as they are, because the said statements might give rise to the belief that the turbines first in the field were inferior machines, and that the Curtis turbine might really be what the author of the article calls "the first great stride in advance of other steam engines." My view is that the people connected with the Curtis turbine will find a good lot of hard work to do before they may call it, not "superior," but "equal" to the Parsons turbine. One important fact not to be overlooked is that there are in a turbine many points which can only be pronounced sound after the full test of time.

BADEN, SWITZERLAND. C. E. L. BROWN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCE.

Induction Motors with Commutators.—BLONDEL.—The continuation of his long article on the theory of these motors, previously noted in the Digest. This installment contains the development of an algebraic theory.—*L'Eclairage Elec.*, June 27.

POWER.

Italian Installation for Power Transmission.—RICCARDI.—An illustrated description of the works of the Societa delle Forse Idrauliche del Moncenisio, which are in course of construction, and which are interesting on account of the exceptionally high waterfall used and of the high potential of transmission. Power is obtained from the River Cenischia, utilizing a fall of 859 meters, with a total of 11,700 hp. The construction of the hydraulic arrangements is described. The power station is situated at Novalesca, and contains at present 3 groups of turbo-alternators. The turbines are of 1,600 hp each for a useful fall of 436 meters at 500 r.p.m., with a flow of 360 liters per second. There are also installed two groups of turbo-exciters, of 110 hp each, with a speed of 600 r.p.m. The alternators are of the triphase type, with rotating magnet wheel and fixed armature, of 1,400 kw. They have 12 poles, and furnish 50-cycle current at 3,000 volts. They receive 12.3 kw for excitation, at 125 volts. The exciters are direct-current dynamos, 6-pole, 75 kw each, at 125 volts, directly coupled to their respective turbines. There are four monophase transformers of 1,100 kw each, oil-cooled, three of them united in star connection, the fourth being in reserve. They step the voltage up from 3,000 to 30,000. They are designed to stand 25 per cent. overload for 2 hours without heating more than to 50°. A description of the switchboard arrangements is also given, as also the construction of the transmission line, which is 60 km long. The sub-station is situated in Turin, and contains at present 3 triphase oil transformers, with air cooling, of 1,000 kw each, which transform the high-tension current to 3,000 volts. It is proposed to use the current mostly for furnishing power for industrial establishments, but it will also be utilized for traction, lighting and electrochemical purposes. The plant at the power station, when completed, will consist of 10 groups of turbo-alternators, 16 monophase transformers and 4 groups of turbo-exciters.—*L'Elettricista*, July 1.

New Power Plant in Livet, France.—A note describing the installation, now in course of construction, of the Société Electrochimique de la Romanche, the power for which will be obtained from the River Romanche. Current will be transmitted at 26,000 volts for 35 km to the city of Grenoble. Turbines of 375 r.p.m. are directly coupled at the central station to two triphase alternators, furnishing current at 3,500 volts, which is stepped up by transformers to 26,000 volts, at which it is transmitted.—*Echo des Mines et de la Met.;* abstracted in *Centralblatt f. Accum.*, etc., July 1.

Power Transmission Plant.—An illustrated description of the power transmission installation of the Apscheron Electric Company in the Russian petroleum district of Baku. The company furnishes motive power for drilling the oil wells, which has been formerly performed by small steam engine plants; 1,500 hp is available for distribution, furnished by steam boilers and engines. Current is generated by two triphase alternators of 700 kw, at 6,500 volts and 100 cycles per second. The current is stepped down to 1,100 volts in transformer stations. The motors are built for 1,000 volts pressure and furnished with 2 armature windings. One of them, which only serves to start the motor or running without load, consists of bronze rods with hard-soldered short-circuit rings, while the working winding proper is constructed as in normal motors. The ends of this last coil, however, do not lead to collecting rings, but to metallic contacts, which after starting the motor and reaching a certain speed, are automatically short-circuited. The contacts are enclosed air-tight, to avoid ignition of any gases which might be present. On account of their simplicity and the freedom from danger of fire, these motors are preferred to the steam engines.—*Zeit. f. Beleucht.*, June 20.

Electrical Equipment of the New Orleans Drainage System.—VENABLE.—An illustrated article describing the installations for pumping the drainage. Only a small amount of power is required constantly and the larger portion of the plant is idle except during and after storms. An economy over steam is, however, effected by being able to concentrate the steam plant at one central station instead of distributing it at several pumping stations. The current used in this equipment is distributed on the three-phase system at 25 cycles per second and 3,150 volts. The motors at the various pumping stations are of the three-phase synchronous type, and are direct-connected to the shafts which carry the moving parts of the centrifugal or screw pumps.—*Elec. Rev.*, July 4.

Transmission and Distribution by Single-Phase Alternating Current.—MONKHOUSE.—A paper read before the recent engineering conference in London. The author points out the greater simplicity of the single-phase system as compared with the polyphase in power transmission and railway work; the chief features which he brings out are well known in the art. He concludes with the statement that the advantages of transmission of power by single-phase alternating current are so apparent that it only remains for a suitable motor to be produced which will give as good results, both as to regulation and efficiency, as are given by the best continuous-current motors, to insure the system being used for long-distance power transmission in the future. In the discussion following the paper, Alexander Siemens pointed out that the whole question of the transmission and distribution of single-phase alternating current hinged on the last difficulty, as the complicated devices necessary for starting single-phase motors and bringing them up to synchronism, did away with all the advantages gained beforehand.—Lond. *Elec.*, June 26.

REFERENCES.

Cost Price of Motive Power.—SAINT-MARTIN.—A long article, in which the author first discusses in detail the conditions obtaining when electric energy is generated by private central stations, in the case of stations exclusively for the transmission of power and of private electric light stations. The second part of the article is devoted to a calculation of power costs for steam engines, non-condensing and condensing, gas engines and compressed air engines, the single items of which are discussed and tables are given. Then follows a comparison between the power produced by the thermal machines and by electric energy, and several typical cases are described where electric motors took the place of steam or gas engines and the economy effected by their use is set forth.—*Bulletin Technologique de la Société des Anciens Eleves des Ecoles Nationales D'Arts et Metiers;* reprinted in *L'Eclairage Elec.*, June 6.

Large Electrically-Driven Punch and Shear.—A note, with illustration, of a large machine, driven by a 20-hp direct-current, slow-speed motor. It has a capacity of punching a 2-in. hole into a 1¼-in. steel plate and weighs about 100,000 pounds.—*Am. Mach.*, July 9.

TRACTION.

Project for Electric Traction on the Swedish Railways.—DAHLANDER.—An abstract of a report made by the author to the Swedish Government, by which he had been commissioned to study the advisability of changing the motive power on the Swedish Government railways from steam to electricity and thus enable the government to make use of the water powers and turf deposits of the country, instead of importing coal. Continuous-current transmission is excluded on account of the length of the railroad system and the small density of population. Polyphase currents with high-voltage transmission and transformer sub-stations also appear unsuitable. The single-phase alternating-current systems are in their present form also unsuitable for application on the Swedish railways. A calculation of costs was made on the supposition that the whole system, of 4,332 km, was operated by electricity. Power was to be furnished by 22 power stations, 17 at waterfalls and 5 at peat bogs. These stations are to furnish single-phase alternating current of 40,000 volts and 25 periods, which is stepped down by transformers along the line to 7,500 volts for the contact cable, the rails to be used as return circuit. The locomotives are furnished with rotary transformers. The speed regulation of the motors is effected by changing the direct-current voltage at the rotary transformer. For passenger and freight trains the locomotives must have 700 hp. The cost of the whole undertaking, including copper, poles, rail connectors, protective devices and installation of the lines, is calculated to average about $2,716 per km. The necessary power is calculated at 120,000 hp, of which 80,400 would be furnished by water power and 21,600 by burning peat. A calculation shows that the expenses for electric motive power would be higher than for steam, but for reasons of political economy the Swedish Government has given its assent to the change to electric traction. Previously, however, the installations in other countries are to be exhaustively studied and an experimental line is to be installed, to work out a suitable system. An article on the report appeared in ELECTRICAL WORLD AND ENGINEER, March 21, 1903.—*Elek. Zeit.*, June 25.

Railroad Motors with Compound Winding.—HOBART.—An article illustrated by a number of diagrams giving the results of tests with a single compound motor having two commutators, and for a combination of two motors arranged on a street car. The single motor is of 35 hp and its construction is described in detail. Under normal conditions the motor runs at 569 r.p.m. with 500 volts, and commutators connected in parallel. The current is taken off by 2 brushes, between which are arranged 172 windings in series. The controller for a street car, provided with 2 of these motors has 9 positions, and curves are plotted giving the characteristic motor curves for all these positions and for all values of the current up to 200 amp. It is stated that from very few experiments it is, therefore, possible to follow the working of the motors and their behavior in the different connections. It is only necessary for this purpose to determine the magnetization curve, and to measure approximately the iron and friction losses, as well as the resistances. If the constructive data of the motors are then known, the determination of the curves is not difficult. Several values for the speed have been determined experimentally and agree well with the values found by calculation. Curves are also given in the article for the efficiency, the speed, the tractive force and the work of the motors for all 9 controller positions. Data and tables on the heating of the motors are also given.—*Zeit. f. Elek.*, June 28.

Return Circuit of the Electric Street Railways in Hamburg.—V. GAISBERG.—A paper read before the recent annual meeting of the German Electrotechnical Society in Mannheim. The author describes the damages which had been discovered in wrought iron and lead water supply pipes, which crossed the street railway tracks. Most of the wrought-iron pipes were perforated by the action of the tramway return currents, while the lead pipes showed an even oxidation. Cast-iron pipes were not affected at all. It was tried to protect the pipes by coating them with tar and also with a mixture of pitch, which was poured upon a shirting ribbon, wound spirally around the pipe. It was found that the tarred pipes resisted better, while the other pipes were especially attacked at the places where the spirals overlapped and their destruction was hastened. It was ascertained that the surfaces which send out destructive currents were comparatively small and they were found only immediately below the tracks or quite near to them. In spite of the electrolytic destruction of the pipes, which was very energetic at some places, only a very small percentage of the 3,000-amp. current can have found its way over the pipe lines. The means adopted to prevent this destruction of pipes consisted in the laying of isolated return cables of about the same thickness as the feeders. In order to ascertain the right current distribution on the return cables, the differences of potential are measured from time to time, and this distribution can be changed by resistances, inserted in the return circuits. The author states in conclusion that the state of the return circuits of electric railways can be watched without much trouble by tests made from time to time. From the experience in Hamburg, where no destruction of pipes has taken place since the requisite measures were taken, he concludes, that any apprehensions on the part of the proprietors of pipe lines in regard to the destruction of pipes by earth currents of electric railways, may now be considered as done away with.—*Elek. Zeit.*, June 25.

REFERENCES.

Urban Railway Traffic.—COTTRELL.—A paper entitled "The relative advantages of overhead, deep-level and shallow subway lines, for the accommodation of urban railway traffic," read before the recent Engineering Conference in London. The author assumes that the operation of these various lines would be by electricity and considers the several systems for conditions obtaining in England. The discussion following the paper is also given.—Lond. *Elec.*, June 26.

Motor Car for Railways.—An editorial discussing the various types of motor cars. The conclusion drawn therefrom is that from a careful study of the whole question, it does not appear that self-contained motor cars, whether steam, petroleum, electrical, or worked on some combined system, are likely to prove serious competitors to electric haulage on urban, suburban or interurban lines carrying a heavy traffic. Their best sphere of action would seem to be in short country branch lines, where high average speeds are not required.—Lond. *Elec. Rev.*, June 26.

Applications of Electricity to Driving Carriages in Towns.—CROMPTON.—A paper read before the recent Engineering Conference in London. The author discussed various points, such as the transmission gear, the storage batteries and the tires. He advocates the standardization of storage batteries and the establishment of charging depots, where the standardized accumulators can be supplied to the owners of electrical vehicles.—Lond. *Elec.*, June 26.

Cost of High-Tension Lines.—A preliminary calculation on the cost of building a line 30 miles in length to carry 15,000 kw at 40,000 volts. The total cost is $163,000.—*St. R'y Jour.*, June 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

New Electricity Works of the Manchester Corporation.—The first part of a well-illustrated article. The plant, with its present output of 26,550 kw, is already the largest electric power distribution undertaking in Great Britain, and with the completion of sets now under construction, the total capacity will be brought up to 34,000 kw. The load is at present divided as follows: About 400,000 lamps are connected to the mains, while over 1,000 motors, of about 4,000 hp, and tramways comprising about 130 miles of single track, with 400 motor cars, are supplied from the stations. The Stuart street station, described in detail in the present issue, supplies three-phase alternating current at 6,500 volts at 50 cycles. This is transmitted through underground cables to sub-stations, where it is converted by means of motor generators into direct current, at 500 to 550 volts for traction, and at 205 and 410 volts for light and power supply. Power is furnished by 24 water tube boilers, each capable of evaporating 12,000 pounds of water per hour at a pressure of 200 pounds per square inch, but working normally at 170 pounds. They are supplied with mechanical stokers of the chain grate type, driven by four motors. There are six main generating sets, each consisting of a 2,500-ihp vertical cross-compound engine, driving direct a polyphase generator of 1,500-kw capacity at 94 r.p.m. The engines and regulating governors are described in detail. The generators are of the stationary armature type, mounted between the high and low-pressure cylinders of the engines, the 64 magnet poles being carried on the periphery of the fly-wheel. Two large slip rings of gun metal,

each provided with four brushes, serve to convey the exciting current into the field magnet winding. The armature is of tie-rod construction, the usual massive frame being replaced by cast-iron cheeks clamping the core laminations together. The structure is strengthened by means of nine tension rods round the circumference, the topmost rod being horizontal and the two lowest rods meeting at a point vertically beneath the shaft. The frame is divided in the horizontal plane. The winding is disposed in the usual way, in two holes per pole per phase. There are also three auxiliary generating sets, each consisting of a three-crank compound engine running at 350 r.p.m. and coupled direct to a 200-kw shunt-wound dynamo of 220 volts. These sets are used for supplying power for lighting the station, and for driving the various motors working the pumps, barring gears, stokers, etc. They can also be used for exciting the main generators. The latter are normally excited by two motor generators, each consisting of a three-phase induction motor fed from the 6,500-volt bus-bars, direct-coupled to a shunt-wound, six-pole dynamo, generating at 220 volts. Each of these sets is provided with three bearings, and the rotor of the motor is fitted with a device to prevent the brushes from being lifted before the rotor is short-circuited, when the machine has been run up to speed. The remaining running machinery consists of two mains chargers, each comprising a direct-current motor coupled to a comparatively large three-phase generator, the latter having to be large in order to carry the capacity current when charging the feeders. There is also a portable motor air compressor, for cleaning the machinery. The switchboards are also described in detail and illustrated. The speed of the engines is controlled by an ingenious electrical device, consisting in effect of a small controller on the switchboard platform, and a small motor mounted on a lever in connection with the governor of each engine. The motor is worked by direct current, and is so arranged that it reproduces exactly the motions of the hand wheel on the platform, thus screwing itself in or out on the lever arm, and varying the effective weight on the governor spindle. Another noteworthy device is a telephone and battery circuit, used for the purpose of synchronizing the engines, not only electrically but also mechanically. The circuit is carried to the valve gear of each engine, which momentarily closes it at a certain point in each revolution of the crank shaft. The make and break is short-circuited in an engine which is at rest. Unless the contacts are made simultaneously on each engine which is running, the telephone circuit will not be complete; hence it is only when the engines are running not only at the same speed, but with their cranks in steps, that the telephone responds.—Lond. *Elec. Rev.*, June 26.

REFERENCES.

Electric Heating Appliances.—REYVAL.—An illustrated description of the appliances in use on the electric line of the Chemin de Fer de l'Ouest, from Paris to Versailles.—*L'Eclairage Elec.*, June 6.

The Charging Tariff Question for Electricity Works.—SCHWABACH.—The author discusses the question of the principle of distributing the fixed charges on the power users, and gives several graphical charts to arrive at the costs.—*Elek. Zeit.*, June 25.

ELECTRO-PHYSICS AND MAGNETISM.

Radium.—CURIE.—An abstract of a lecture delivered by the well-known French scientist before the Royal Institution, London. The lecture was illustrated by many experiments. Prof. Curie demonstrated that radium emitted heat, by noting the difference in temperature between two small cylinders of equal size, one of which contained 7 decigrams of radium. This difference was 3° C. A piece of radium was lowered into a glass vessel containing liquid air, to show that its radiations persisted even at that temperature, and the light emitted by the radium appeared equally bright whether the metal was in the liquid air or not. The discharging action of radium was also shown by approaching it to the knob of a charged gold leaf electroscope. The emission of three different classes of rays by radium was discussed. The deflection of the B rays was shown by the accelerated discharge of the leaves of an electroscope, when the rays were deflected by an electromagnet on the knob of the instrument. Induced radioactivity was also illustrated. A piece of cardboard was made radioactive by the radiation from a solution of a radium salt and then taken near to an electroscope, which it discharged. A still more striking experiment showed that the radium emanation could be condensed by liquid air, and again allowed to diffuse in a manner analogous to a gas. Two bulbs, one above the other, were used, both containing sulphide of zinc. The upper one was first made radioactive, and by means of liquid air the emanation was condensed into the lower bulb, which became more brilliant. On being left alone, however, the upper bulb again increased in brilliancy, while the light from the lower bulb decreased. Another experiment showed how radium rays facilitate the passage of the spark from an induction coil. Two spark-gaps were connected in parallel, and when radium was approached to either one of them, the sparking in the other ceased. A very striking demonstration of the fact that radium emanations possessed heat energy was the boiling of liquid air through its agency. The remarkable property of radium of altering the coloring of crystals and other solid bodies was also touched upon, as sodium chloride becoming blue, and glass violet under the influence of the rays. It was also pointed out that in these researches the electroscope was 10,000 times more sensitive than the spectroscope. In conclusion, Prof. Curie touched briefly on the hypotheses put forward to account for these phenomena, without, however, expressing his own opinion as to the probability of these hypotheses being correct.—Lond. *Elec.*, June 26.

Coherers.—HURMUZESCU.—A long article, in which the author, after a thorough historical exposition of the work done on the coherers and the attempts to formulate a theory of their action, describes experiments undertaken by him with a view to ascertain whether the variations of the resistance of the coherers under the action of the waves, depend upon the time during which the latter act. He therefore measured the time of action and the variation of resistance during this time. From the experiments made with a number of coherers and various dielectrics the author deduces the following conclusions: 1. In a general way, metallic filings become good conductors of electricity under the action of electric waves. 2. All coherers present a minimum in the value of their electric resistance relative to the time during which the electric wave acts. 3. This change of resistance is permanent for most of the systems. There are, however, a number of cases, where this modification ceases at the same time as the cause which has brought it about. These are the systems, carbon-carbon, metal-carbon, iron-mercury, etc., or the coherers with spontaneous decoherence. 4. But all these systems lose the property of spontaneous decoherence on account of a feeble oxidation or of a too rapid fatigue of the coherer by employing electric waves of too great intensity. These phenomena of auto-decoherence have been obtained for a great number of systems, in the first period, at the beginning of each experiment. 5. For certain systems, such as iron-manganese, silver-manganese, the action of the waves diminishes their resistance at first; then, when the waves are allowed to act again, an increase of the electric resistance of the coherer is found. These systems, therefore, behave in the first phase like ordinary coherers, in the second phase like anti-coherers. 6. A large number of ordinary coherers, when their contact surfaces are moist or dip into a dielectric containing water, present the two above phases, that is, by the first action of the waves, their resistance diminishes, to increase towards its original value by a subsequent action. According to different conditions, the first phase is more or less abbreviated and it can even disappear in some of the systems. In this latter case one deals with anti-coherers. 7. All these phenomena depend upon a layer between the contact surfaces; the intervening dielectric influences this layer, be it through the interval, or through the oxide or through gas condensed on the surfaces themselves. The author offers the following explanation of his results. The existence of the minimum of variation of the electric resistance of the coherers, relative to the time during which the electric wave acts, leads to a common explanation for the coherers and anti-coherers. For the former the action of the electric waves would be simply to diminish the resistance down to the vicinity of the minimum. This minimum would correspond, for a system, to the maximum coherence; that is to say, the formation of chains between all the grains following the direction of the current. For the latter, these metallic chains, formed by the small sparks jumping over between different grains, would find themselves interrupted on account of the introduction of new resistances into the path owing to the oxidations due to the sparks themselves. These oxidations depend on the nature of every metal and the dielectric with which it is in contact. If, according to the nature of the metal and the surrounding dielectric the oxidation is produced very quickly by the first spark, the first phase of the phenomenon (the fall of resistance) can escape us; this is the case of the anti-coherers.—*Annales Scientifiques de L'Universite de Jassy*; reprinted in *L'Eclairage Elec.*, June 27.

Electric Conductivity of Selenium.—VAN AUBEL.—A note presented to the French Academy of Sciences, on the electric conductivity of selenium in the presence of bodies treated with ozone. The author subjected a leaf of red caoutchouc to the influence of a current of dry ozone during twelve minutes. Some selenium, the resistance of which was 599,000 ohms, was allowed to be acted upon by the radiations sent forth from the caoutchouc, and after 15 minutes the resistance of the selenium fell to 556,000 ohms. A brass screen was then introduced and after one hour the resistance had gone up again to 563,000 ohms. The next morning the selenium had arrived at its former conductivity. Similar results were obtained with pieces of camphor.—*Compt. Rendus;* abstracted in *L'Eclairage Elec.*, June 13.

Changes in Length of Ferromagnetic Substances.—HONDA AND SHIMISU.—The authors carried out experiments on the change of length of ferromagnetic substances under the influence of magnetization at high and low temperature. The temperature was raised to 1000° C., and tests were also made in liquid air. The substances experimented upon were nickel, soft iron, tungsten steel, cast cobalt and annealed cobalt. Curves are plotted for each of these materials. The authors come to the following conclusions: In comparing the results for soft iron, tungsten steel, cast and annealed cobalt, the curious fact is observed that the changes of length of these metals, which are so different at ordinary temperature, take an extraordinarily simple character at high temperatures, in so far as they tend to become proportional to the magnetic force, a fact which has without doubt an important bearing on the theory of molecular magnetism.—*Phys. Zeit.*, June.

REFERENCE.

Notes on X-Light.—ROLLINS.—The continuation of notes on this subject, dealing mainly with small versus large induction coils for exciting X-light tubes.—*Elec. Rev.*, June 27.

ELECTRO-CHEMISTRY AND BATTERIES.

Manufacture of Sodium by Electricity.—BECKER.—A description of the processes of Becker and of A. H. Cowles. The Becker process depends on the decomposition of sodium chromate, tungstate, etc., and carbon in an electric distillation furnace, the sodium being distilled off and being condensed afterwards, while metallic chromium remains. By treating mixtures of different salts and oxides, it is possible to produce alloys. The Cowles process depends on the reduction of sodium aluminate with the production of aluminum carbide and metallic sodium, which distills off and is condensed as above. If iron or copper is added to the sodium aluminate, ferro-aluminum or cupro-aluminum is obtained instead of aluminum carbide.—*L'Industrie Electrochimique,* June.

Production of Metallic Calcium by Electrolysis.—A description of the process of the Electrochemische Werke. The calcium is obtained by electrolysis of fused calcium chloride, in a furnace with carbon walls as anode and a small rod of iron inserted through an insulated bottom, as cathode. The main point in the process is that the electrolysis is conducted at a temperature below the fusing point of the calcium. The latter, therefore, separates on the anode in a spongy mass, containing about 50 per cent. of metallic calcium. This spongy mass is compressed, while still in the electrolyte, with tongs or in any other suitable manner, and removed from the electrolyte. It presents a metallic fracture and contains nearly 90 per cent. of metallic calcium.—*L'Industrie Electrochimique,* May.

The Thallium Accumulator.—JONAS.—An article in which the author investigates the reactions taking place in a thallium cell, as they are of considerable theoretical interest, in so far as the battery is only composed essentially of a metal and water. One electrode is metallic thallium and the other consists of oxide of thallium, while a solution of thallium hydroxide serves as electrolyte. The author first investigates the deposit obtained upon the anode by the electrolysis of thallium hydroxide, and finds that it is not a hydrate, but after drying at 200° corresponds approximately to thallic oxide. Reactions are calculated according to which the discharge of a storage battery consisting of thallium, thallium peroxide and dilute thallium hydrate solution, takes place, and the theoretical value of the capacity of such an element is determined as 235.2 amp.-hours per kgm of thallic oxide, and 131.4 amp.-hours per kgm of metallic thallium, differing from former values given by Marsh as 117 amp.-hours per kgm of the oxide. The author also gives measurements of the potentials with a number of different solutions.—*Zeit. f. Electrochem.*, June 25.

Electromotive Behaviour of the Oxides of Cerium.—BAUR AND GLAESSNER.—A theoretical investigation with measurements of the oxidation and reduction potentials of various cerous and ceric salt solutions against a normal electrode; such cells appeared to offer a means for obtaining energy from the cold combustion of organic materials. The work was undertaken, as Auer von Welsbach is said to have patented an accumulator consisting of a cerous and a ceric electrode. The authors also investigated cells made of ceric and cerous salt solutions, with different depolarizers in the cathode and anode compartment. They conclude that the probability appears small; that with the employment of watery solutions, elements of such type with a practical efficiency could be produced.—*Zeit. f. Electrochem.*, June 25.

Sulphides of the Alkaline Earths.—BROCHET AND RANSON.—An article dealing with the electrolysis of barium sulphide, in order to find what reactions are taking place. The authors found that the electrolysis takes place substantially in the same manner as that of the alkali sulphides, particularly sodium sulphide. In a dilute solution sulphur, sulphite, hyposulphite and sulphate are formed, which being mostly insoluble separate at the anode. In concentrated solutions, sulphur, barium hydrate and hydrogen are obtained. Electrolysis had to be performed at an elevated temperature, because the sulphide, and especially the hydrate of barium, are very difficultly soluble in the cold.—*Comptes Rendus.*, Vol. CXXXVI, p. 1195.

REFERENCES.

Electrochemical Reduction of Aromatic Nitro Bodies.—ELBS AND STOHR.—The authors discuss the increase of resistance, which gives rise to disturbances when their method of reducing aromatic nitro bodies with the production of azo and hydrazo-bodies and benzidines, is carried out. They give directions for overcoming this disturbance.—*Zeitsch. f. Electrochem.*, June 25.

Utilization of Nitrogen of the Air.—FRANK.—A description of the authors' experiments for the absorption of nitrogen of the air by calcium carbide and barium carbide.—*Zeitsch. f. Carbidfabrikation,* June 12.

Electric Smelting Furnace.—An illustrated description of a recent construction by Harmet.—*L'Industrie Electrochimique,* June.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Potentiometer for Thermocouple Measurements.—LEHFELDT.—A description of an instrument which the author has constructed for the above purpose with a view of not introducing a high resistance into the circuit of the couple and galvanometer and also avoiding accidental thermoelectric forces. The only metals used in the measuring circuit are copper and manganon.—*Phil. Mag.*, June.

Packing of Electrical Instruments for Export to India.—BRUEHL.—An abstract of a paper read before the Calcutta Local Section of the English Institution of Electrical Engineers. The author recounts his experiences with the deplorable state of scientific instruments upon their arrival in India. The suggestions contained in the article should prove interesting reading to manufacturers of electric instruments and machinery, exporting to the tropics.—Lond. *Elec.*, June 26.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Signal for Railroad Crossings.—A note containing a description of a new signal installed at the crossing of a German electric road with a steam road. The apparatus consists of an electric motor driven from a power circuit; it actuates a bell, and at the same time furnishes current for 4 incandescent lamps. Three contacts are arranged, two of which are 500 meters in front and back of the crossing respectively and one at the crossing. The train, when it strikes the first contact, starts the motor which in turn actuates the bell and lights three of the incandescent lamps, which are set in a lantern, bearing the inscription, "Train comes." When the train strikes the contact at the crossing, the bell and glow lamp circuit is disconnected again. The fourth lamp is a control lamp at the railroad station, which is disconnected, when the train strikes the third contact. This simple device is stated to work very well.—*Dinglers Polyt. Jour.*, June 27.

Telephone Exchange.—An illustrated description of the equipment of the Geneva Telephone Company, at Geneva, N. Y.—*Elec. Rev.*, July 4.

New Books.

DIES: Their Construction and Use for the Modern Working of Sheet Metals. By Joseph V. Woodworth. New York: Norman W. Henley & Co. 384 pages, 505 illustrations. Price, $3.

This is a very practical and useful manual devoted to the subject of working in sheet metal for the production of the stamped articles that have now become so familiar and useful an appliance. Mr. Joseph V. Woodworth, the author, is said to be a skillful and experienced workman in this department, and these pages give every indication of his thorough familiarity with the design, construction and use of the necessary tools and appliances, as well as with the handling of the raw material in such manner as to secure the largest amount of output with a minimum of cost and waste.

There are a dozen chapters in the book devoted to the various kinds of dies for bending, forming, perforating, etc.; to coining processes, drawing, annealing steel tools, etc.

HARDENING, TEMPERING, ANNEALING AND FORGING OF STEEL. By Joseph V. Woodworth. New York: Norman W. Henley & Co. 280 pages, 200 illustrations. Price, $2.50.

The author of this book is also the author of the kindred work itself, both of them covering to some extent the same ground. The present work is one which should prove of great usefulness to all who desire to become thoroughly acquainted with the modern processes of heating, annealing, forging, welding, hardening and tempering steel, and there is no doubt that workers in this field will also derive considerable benefit from its practical directions and suggestions as to the manner in which work can best be done. A number of simple and successful processes are described, and the twelve chapters of the book deal in succession with the steel itself, with its treatment in the form of sheet, tools, dies, etc.

Chapter II is devoted to miscellaneous kinks, and throughout the book abounds in data of extremely practical character.

THE STORY OF A GRAIN OF WHEAT. By W. C. Edgar. New York: D. Appleton & Co. 40 illustrations.

This is a very interesting book on a most important subject, written by a man thoroughly competent to deal with his subject. A vast amount of information is brought together, within these pages, Mr. Edgar, as editor of the *Northwestern Miller*, being able to supplement purely historical data with the observations and conclusions of a trained observer dealing with current facts every day, and aiming to understand the tendencies of the industry with which he is so closely associated.

In one respect, perhaps, and that by no means of minor consideration, Mr. Edgar is more optimistic than some people we could quote. The very day before writing this review of his book, we noted in one of the serious newspapers a statement to the effect that wheat stores are now about as low as they ever were, and that the farmers might count confidently on steadily better prices for their product because of growing demand and a supply that does not keep pace with it. But Mr. Edgar remarks: "In wheat production nature keeps ahead of man's requirements." There is certainly a clash of authority on that point. So far as general discussion of the subject goes, we need only refer the reader to Sir William Crookes' discussion of the problem, and his insistence on the point that in order to secure the wheat supplies needed in the near future, nature's exhausting reserves of fixed nitrogen must be supplemented by those of the atmosphere. Such work as this, it is well known, Mr. C. S. Bradley has been doing successfully at Niagara with the aid of electricity, and it seems to us that by such work rather than by unaided nature, the nations are likely to be furnished with their daily bread—but they may have to pay more for it, as they are already beginning to do for their daily fuel.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

AMERICAN ORDER OF STEAM ENGINEERS. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., third Wednesday in June, 1904.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

ENGINE BUILDERS' ASSOCIATION. Secretary, F. P. Ide, Springfield, Ill.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Wm. J. Davis, Ithaca, N. Y.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, Utica, N. Y.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 104 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION. Secretary, E. W. Pichardt, Huntingburg, Ind.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

The Central Union Telephone Company in Indiana.

The Central Union Telephone Company is moving its headquarters from Chicago to Indianapolis and in a few days will have its large office force in good working order. In view of the fact that it is generally believed that the Central Union is losing ground in Indiana, a synopsis of its annual report just filed with the State Tax Board may prove of interest. The report shows that the company had in use in the State on the first day of April 40,224 business telephones and 74,773 residence telephones, at an average rate charge of $2.10 per month for business, and $1.23 for residence, against 46,336 business telephones and 61,422 residence instruments at an average charge of $2.05 and $1.19 respectively during the previous year. The gross earnings for the year were $3,004,103.03 and the net earnings $173,706.63, while for the year previous they were $2,584,789.42 gross and $224,526 net respectively.

The company has 4,159½ miles of poles in Indiana and 55,808¾ miles of wire, an increase during the year of 117 miles of poles and 12,691½ miles of wire. The original cost per mile of the line is given at $160. Iron, steel and copper wire is in use and there is an average of four wires to each line of poles. The average height of the poles is 30 ft. and 25 poles are set to the mile. The cost per 100 of these poles is given at $100. The company owns real estate in Indianapolis assessed at $52,000. The capital stock is given at $3,587,100 and the number of shares 35,871 of a par value of $100, and market value of $30. The bonded indebtedness is given as $6,000,000. For officers' salaries $303,159.32 were paid out and $446,566 for labor. The expense of offices and stations amounted to $835,309, and $587,499.89 was expended for materials, etc.; for royalties and interest, $611,895.49, and for taxes, messengers and miscellaneous, $219,672.

Dry Battery.

The Electric Contract Company, 202 Centre Street, New York, is making a dry cell that is particularly recommended for automobile and gas engine ignition work. In designing this cell the object sought was a high discharge rate compatible with long life, and this desideratum, it is claimed by the manufacturer, has been notably realized.

Each cell is tested before being sent out, and if it is not up to the standard it is not shipped. This care bestowed upon the goods enables the company to guarantee a high efficiency for the cell.

These cells are made in four sizes of the following dimensions: 5 in. x 2 in.; 6 in. x 2½ in.; 7 in. x 3 in., and 8 in. x 3½ in.

Detroit Convention of the National Electrical Contractors' Association.

The third annual convention of the National Electrical Contractors' Association took place at Detroit, Mich., July 14, 15, 16 and 17. The enthusiasm shown and the large attendance were a revelation even to those who have watched the progress made by this important body in its existence of only three years. It was an indication of the promiment position occupied in the electrical industry by the electrical contractor to-day, and while the meetings are not yet taken up with the discussion of papers on technical subjects, practical affairs are talked over and the general interests of the contractors are safeguarded thereby. They are brought together, and the result is beneficial to the contractor, his employee and the public.

On the opening day the arrival of the Eastern delegation in the early morning was attended by some amusing exercises and a mock parade. An executive session of the directors was held at 10 o'clock, at which a nominating committee was selected. At 2 o'clock the convention went into open session and the delegates were formally welcomed to the city by Mayor Maybury. The mayor, in his customary happy manner, extended the freedom of the city to the delegates, and called attention to the fact that the greatest electrician of the age—Thomas A. Edison—was once a Michigan lad, who took his first lesson in the craft as a messenger boy between his home, Port Huron, and Detroit.

President Charles L. Eidlitz responded, declaring that the welcome given to the members of the association, and the treatment accorded them by the citizens of Detroit, will always live in their memory.

Immediately following the speeches, the convention again went into executive session and all the proceedings were conducted in executive session, so that no report can be given of the transactions.

The officers elected were Earnest McCleary, Detroit, president; first vice-president, W. I. Gray, Minneapolis, Minn.; second vice-president, W. C. McIntyre, Philadelphia, Pa.; treasurer, J. R. Galloway, Washington, D. C.; secretary, W. M. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.

The Detroit Light Guard Armory, large and commodious as it is, was none too large for the exhibit of electrical apparatus put in use by the electrical contractor, and over fifty manufacturers took advantage of the opportunity to display their various lines. The exterior of the building was handsomely decorated with electric signs and flags put up by the Elblight Company, of New York, which also did all of the interior decoration in illuminating effects with great skill and success.

EXHIBITS.

MARSHALL-SANDERS COMPANY, Boston, had a very interesting exhibit of its specialties, and Mr. L. W. Kittman was most affable and painstaking in showing the line.

"HYLO" LAMPS will be long remembered through the efforts of W. J. Phelps, W. E. Phelps and J. Wiley Phelps.

THE OLD HOUSE of Partrick, Carter & Wilkins, Philadelphia, sent along W. W. Winship to display their annunciators and some of their house goods specialties.

THE NUNGESSER ELECTRIC BATTERY COMPANY, Cleveland, Ohio, was represented by H. G. Robbins, who gave out a handsome little button as a souvenir.

WESTERN ELECTRIC COMPANY had adequate representation in Major R. Edwards, Jr., C. W. Cobb, E. R. Field and L. J. Baldwin.

MANHATTAN ELECTRICAL SUPPLY COMPANY, in its exhibit showed only a few of its products, the Mesco batteries, a line of sockets, receptacles and other specialties for contractors. Mr. J. W. McDowell, of New York, attended to all visitors and inquirers and gave away the most valuable souvenir at the convention.

JOHN A. ROEBLING SONS COMPANY.—Visitors to the booth of John A. Roebling Sons Company were cordially greeted by Frank W. Harrington, W. F. Richardson, W. P. Bowman, W. W. Affleck, G. W. Swan, C. B. Cushing and J. W. Brooks.

THE NATIONAL X-RAY REFLECTOR COMPANY exhibited a line of its silver-plated glass reflectors, Mr. E. L. Haines, general manager, of Chicago, representing it.

VALENTINE CLARK COMPANY, Chicago, sent Mr. Ernest E. Clark to talk about its poles, ties, cross arms, etc.

THE PERU ELECTRIC MANUFACTURING COMPANY was somewhat delayed in getting its exhibit in shape, but it was pushed through. It was represented by R. H. Bouslog and George S. Searing.

GEORGE F. PORTER, ex-secretary of the National Electric Light Association, was in active attendance in the interests of the Atlantic Insulated Wire & Cable Company. Even this veteran of conventions opened his eyes at the attendance and display.

MICHIGAN BOLT & NUT WORKS booth was in charge of Mr. H. MacLean and Frank S. Bigler.

PASS & SEYMOUR, Solvay, N. Y., made a splendid exhibit of their well-known specialties, and through the untiring efforts of Mr. W. Brewster Hall, of New York, and J. W. Brooks, Chicago, it was made most interesting. Souvenirs were given away.

CROCKER-WHEELER COMPANY, Ampere, N. J., was represented by Mr. F. S. Blackall, of New York.

MR. M. B. AUSTIN was there in person for the M. B. Austin Company, Chicago.

AMERICAN ELECTRICAL HEATER COMPANY was out in force, B. H. Scranton, president; John Scudder, secretary-treasurer, and George J. Schneider, superintendent, being very much in evidence.

ALPHADUCT MANUFACTURING COMPANY had an interesting exhibit of its flexible conduit, Mr. W. M. Porter, Western manager, meeting all his friends and incidentally distributing a smoking pipe made of the conduit.

CROUSE-HINDS ELECTRIC COMPANY.—A most elaborate exhibit was made by the Crouse-Hinds Electric Company, of Syracuse, N. Y.. As one came down the main isle the first thing that greeted the vision were lightning flashes radiating from a blaze of light in the booth, the center having a wreath which formed the trade mark of the company. The center of the trade mark contained a Syracuse changeable electric head light, one of the company's many products. Directly above this wreath was the sign "Norbitt" made of changeable monograms. The booth was surrounded by railing made of heavy quartered oak and supported on ornamental brass pedestals,

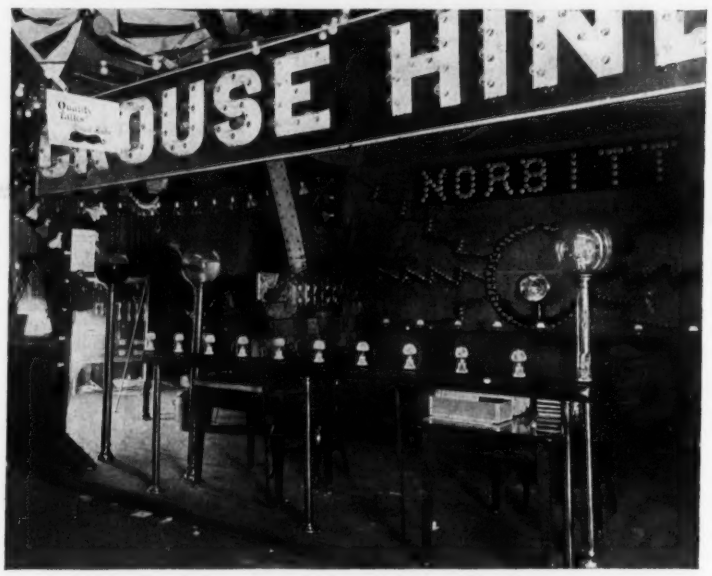


EXHIBIT OF CROUSE-HINDS ELECTRIC COMPANY.

the top of the railing being utilized for exhibiting the Norbitt moulding and conduit receptacle all electrically connected. At the entrances to the booth, of which there were two, were four cut glass aquariums supported on pedestals, similar to the railing. In the interior of each aquarium was placed a Norbitt temporary decorative socket with a 16-cp lamp. Two of the aquariums contained battery fluid and two water with gold fish, showing the waterproof qualities of the appliances. To the left of the entrance of the booth was the red room, devoted to the display of switchboard and panel boards. The decoration consisted of over 400-cp ruby lamps, each embedded in a flower-shaped shade, festooned about the walls and ceilings in good taste. Extending the entire length of the exhibit was an enormous electric sign, reading "Crouse-Hinds." The entire equipment consisted of over 1,100 8-cp lamps. The various circuits feeding these lamps were controlled from a marble panel enclosed in an oxidized copper-trimmed metal cabinet. Around the walls of the booth were many different designs of panels enclosed in cabinets of oak, maple, mahogany and cherry. The "Quick Put Up" Norbitt appliances were in great demand by exhibitors for decorating their booths. Mr. Hawkins, Mr. Norden, Mr. Hills and Mr. Crofoot certainly deserve credit and are to be congratulated for the fine display they made of their company's product. In keeping with their custom in the past, they distributed a souvenir in the shape of a very handsome leather bill folder for pocket use.

THE MICHIGAN ELECTRIC COMPANY was represented by Mr. Henry F. de B. Cameron, R. J. Thorne, E. Bullock and Joseph E. Lockwood.

KUHLMAN ELECTRIC COMPANY, of Elkhart, Ind., had its transformers talked about by Mr. K. Kuhlman.

MCBRIDE MANUFACTURING COMPANY "Arkless" fuses were spoken for by Mr. B. D. Horton.

THE GOULD STORAGE BATTERY COMPANY had Mr. E. L. Draffen, of the Chicago office, in attendance.

THE JEWELL ELECTRICAL INSTRUMENT COMPANY, Chicago, had Manager Edward M. Jewell on the scene.

THE ANDERSON PORCELAIN COMPANY, East Liverpool, Ohio, sent Mr. Howard H. Balliett.

J. H. MCGILL, sercetary and manager of the Crescent Company, Chicago, distributed neat little souvenirs advertising its soldering sticks.

THE ADAMS-BAGNALL COMPANY had Mr. J. G. Pomeroy in attendance talking the merits of A. B. arc lamps better than ever.

FOSTORIA INCANDESCENT LAMP COMPANY was represented by Chas. J. Wells from the home office.

TRANSPORTATION.—Mention should be made of the great comfort secured to the Eastern delegation and inconvenience avoided, through the efforts of Alex. Henderson, master of transportation of the Association. The trip was made most pleasant and excellent accommodations were provided for all at Detroit by Mr. Henderson. Such service went far to make the convention a success, and means hard work for the man thus aiding his fellows.

M. B. WHEELER ELECTRIC COMPANY, Grand Rapids, Mich., was represented by Mr. M. B. Wheeler, who added greatly to the convenience of all those attending the convention by having a printed list distributed of those attending the convention under three classifications—members, exhibitors and visitors. This enterprise was much appreciated, and Mr. Wheeler received profuse thanks from delegates and exhibitors.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY made a striking display of its latest designs in wireless instruments. The company was ably represented by the inventor of the apparatus, T. E. Clark, assisted by Ackland Stilling and Gustave I. Riefstahl.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY showed a line of telephones. Its switchless telephone and the new push button telephone attracted considerable attention. Mr. A. S. De Veau and V. C. Gilpin, sales manager, looked after the interests of the company most pleasantly.

THE DALE COMPANY exhibit of electric lighting specialties was a most attractive one, so much so that the entire exhibit was sold and removed by the purchaser at the close of the convention. Many orders were booked for portables and half-shade reflectors, and through the efforts of J. H. Dale and O. J. Bryan, who represented the company, many new customers were won. Handsome souvenirs were distributed by the Dale Company.

HOLTZER-CABOT COMPANY, Boston, had a very interesting exhibit in charge of E. R. Harding, Chicago, whose acquaintance amongst the delegates and visitors kept him busy.

FLEXDUCT.—A very handsome exhibit was that of "Flexduct," the product of the Osburn Flexible Conduit Company, New York. The success of the display was enhanced by the presence of C. E. Corrigan, who greeted warmly all his old friends and all visitors. He was ably assisted by C. B. Roulet.

HART MANUFACTURING COMPANY, Hartford, Conn., showed a full line of "Diamond H" switches. Two well-known representatives—Wm. Taylor, New York, and W. P. Crockett, Chicago—greeted a host of friends.

THE JOHNSON & MORTON EXHIBIT was one of the centers of attraction. It was in charge of W. H. Morton, the popular secretary of the National Electrical Contractors' Association, whose untiring efforts have gone so far to make the association the success it is.

NATIONAL CARBON COMPANY had on display its dry batteries, brushes, etc. It was represented by Edmund J. Climo and F. J. Kysela, Cleveland.

BISSELL.—The interests of the F. Bissell Company, Toledo, Ohio, were looked after by Fred Bissell and M. S. Walker.

FRINK REFLECTORS were not forgotten, through the presence of Mr. Frank Stout.

CARLETON-CHASE ELECTRIC COMPANY, New York, made a most unique and novel exhibit in the form of a miniature reproduction of its entire building in New York. The model, about 6 ft. high, 2½ ft. x 5 ft., was illuminated, and made a very pretty effect. J. A. Vaughan and Percy R. Frost looked after the interests of the Company in a most painstaking way and handed around a very pretty souvenir.

NATIONAL INDIA RUBBER COMPANY, Bristol, R. I., showed samples of its goods from raw rubber to the finished product. P. F. Lyons was in charge of the display. Orla White was also in attendance.

A. R. HUSSEY showed a line of telephones, the product of the Allen-Hussey Company, Chicago.

THE NORDEN-BITTNER ELECTRIC COMPANY, of 1402 Broadway, New York, was represented by Mortimer Norden, who explained the company's changeable electric signs to the various contractors, a number of whom desired to handle it in their cities.

J. A. MALTBY came on from Bay City to take charge of the exhibit of the Maltby Lumber Company and greet his many friends.

THE SEIDLER-MINER COMPANY had a worthy exhibit, and were represented by B. F. Seidler and Frank J. Miner, the latter gentleman being mostly responsible for the great success of the entire Armory exhibition.

THE SPRAGUE ELECTRIC COMPANY exhibit was in charge of Alex. Henderson, New York, assisted by E. B. Kittle, Chicago.

FORT WAYNE ELECTRIC WORKS showed a line of arc lamps, meters, etc., in charge of H. L. Searles, assisted by Frank Ross.

THE ELBLIGHT COMPANY'S exhibit, as at all conventions, attracted great attention. Its display showed many new features and designs, and Russell Spaulding and E. H. Abadie were assiduous in their attention to all visitors. Mention should be made of their superintendent, J. C. Schaeffer, who was in attendance and looked after the fine Elblight decorations throughout the building.

R. B. COREY talked for his several lines made by Hart & Hegeman Manufacturing Company, Bossert Electric Construction Company and American Circular Loom Company.

UNITED ELECTRIC HEATING COMPANY, Detroit, made a splendid display of electric heating and cooking apparatus, Mr. Robert Kuhn representing.

DETROIT SIGNAL COMPANY exhibit was in charge of Capt. Holmes and H. Fessenden.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY received visitors in a handsomely decorated booth through Charles F. Medbury, W. C. Armstrong, R. L. Rathbone and C. S. Jennings—the latter of the Sawyer-Man forces in New York.

NERNST LAMP COMPANY had on hand T. H. Bailey Whipple, Pittsburg, and A. E. Fleming, Chicago, to talk the merits of the lamp.

ELECTRIC APPLIANCE COMPANY, Chicago, was well represented by S. A. Rall and W. P. Upham. Its booth was tastefully arranged with a large line of its supplies.

FULLER ELECTRIC COMPANY.—Among the interesting things was one of the very first direct-connection high-speed dynamos ever constructed in the United States. It was built in 1882 by Rodolphus Fuller, present secretary and manager of the Fuller Electrical Company, of Detroit, and was installed in Chicago. This dynamo was used in lighting a railroad train by electricity for many years by the Grand Trunk, between Chicago and Port Huron. By its side on the platform stood a machine of the same power and speed built according to the latest plans. Another unique exhibit by the Fuller Company was a ventilating fan six feet in diameter, said to be the largest fan ever built with a direct-connected motor, and capable of handling 120,000 cubic feet of air a minute. This company also manufactures all sorts of marine lighting devices, many of which were exhibited in their booth. Mr. R. Fuller and F. Vollmer were in charge.

AMERICAN CIRCULAR LOOM had a handsome exhibit and an army of handsome representatives, in H. B. Kirkland, Jas. L. Kirkland, R. B. Corey, T. H. Bibber and T. G. Grier. Circular loom was well exploited. Handsome buttons were distributed, as well as Mr. Grier's latest literary effort, "Advice to young men."

AMERICAN PUSH BUTTON TELEPHONE COMPANY displayed its new types of telephones through the efforts of W. F. Van Benthuysen and W. V. Sweeten, the latter having just returned from a successful trip to the Pacific coast.

ELECTRIC GAS LIGHTING COMPANY, Boston, had a large display of its various products such as bells, annunciators, etc., as well as the long-established Samson batteries. Great pains were taken by Chas. E. Lee and T. H. Sherman to explain the merits of the goods.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, of Utica, had a considerable display in charge of F. T. Foxenberger, of Utica.

CHASE-SHAWMUT COMPANY had an elaborate exhibit of some of its specialties which attracted great attention. Mr. Harry P. Moore, of the Boston office, was kept busy describing their merits and giving away as a souvenir a cigar cutter made in the exact shape, in miniature, of the Shawmut fuse.

H. L. WALKER COMPANY, Detroit, showed a line of supplies, H. L. Walker, W. J. Hartwig and J. R. McNaughton being in charge.

BROWNING MANUFACTURING COMPANY, Milwaukee, showed a line of dynamos and motors. They were well advocated by S. A. Bean, of the head office, and H. B. Wilkins.

S. B. CONDIT, JR., & Co., Boston, sent Fred W. Nason, who kept busy talking the merits of Elden circuit-breakers, and explaining the good points of their new laminated type, which is fully described in their July bulletin just issued. Only the most important business elsewhere kept Mr. Condit from attending the convention.

ELECTRICAL WORLD AND ENGINEER was represented by Messrs. J. V. S. Church, of Chicago, and G. W. Elliott, of New York. It had a booth in the Armory to receive callers and distribute papers.

BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, made an exhibit of its wireless specialties, which elicited favorable comment. Mr. R. B. Benjamin, manager of the company, was in charge.

BALL & WOOD ENGINE COMPANY were represented by Mr. J. H. Parshall, of Detroit.

AMONG THOSE PRESENT were C. A. Glack, American Conduit Manufacturing Company; W. C. Osborne and C. D. Goss, Sterling Electrical Manufacturing Company; D. B. Scarborough, Vallee Bros. Electric Company; H. W. Cook, John Toler Sons Company; G. L. Crosby, The Cutter Company; H. E. Wronk, W. R. Ostrander Company; G. W. Rodormer, Chicago American Electric Fuse Company; A. S. Hatch, Municipal Lighting Commissioner, Detroit; Prof. W. E. Goldsborough, St. Louis Exposition.

ATTENDANCE AT THE CONVENTION.

The following were the members registered in attendance:

BALTIMORE, MD.—H. K. McCay, F. G. Boyd, John K. How.

BOSTON, MASS.—Seth B. Witherbee.

BUFFALO, N. Y.—F. P. Jones, F. H. Williams, W. Allan Gardner, J. C. Sterns, E. D. McCarthy.

CHICAGO, ILL.—C. R. Kreider, C. E. Browne, H. H. Deenis, H. T. Lounsbery, Arthur Frantzen.

CINCINNATI, OHIO.—E. M. Lawton.

COLUMBUS, OHIO.—J. C. McMaster, John Ryan, Mark Simonton.

DAVENPORT, IOWA.—J. N. Butterworth.

DAYTON, OHIO.—Charles P. Gutin.

DES MOINES, IOWA.—Edward Kunkel.

DETROIT, MICH.—E. McCleary, Jos. E. Lockwood, H. Colquitt, H. Cameron, Thos. E. Clark, Wm. H. Sheldon, Jr., B. F. Seidler, Hiram Marks, F. C. Teal, Geo. F. Kearney, A. Miller, F. J. Miner, E. W. Haines, Chas. A. Schmidt, D. A. Britten, Dan. L. Shoebottom, D. Donahue, James Rathbun, Geo. H. Jacobs, R. J. Thorne, Edward Bullock, J. D. Templeton.

DULUTH, MINN.—Wm. Burgess.

GRAND RAPIDS, IOWA.—M. B. Wheeler, H. A. Roseberry.

HARTFORD, CONN.—Harvey E. Paige.

INDIANAPOLIS, IND.—W. A. Royse, F. W. Cheyne, G. M. Sanborn.

JACKSONVILLE, FLA.—A. A. Kind.

KALAMAZOO, MICH.—Henry M. Desenberg.

MINNEAPOLIS, MINN.—G. M. Jones, W. I. Gray, W. J. Chapman, L. L. Saunders.

NEW YORK.—Charles L. Eidlitz, F. S. Blackall, P. C. Haviland, J. S. Hatzel, E. S. Keefer, James R. Strong.

PHILADELPHIA, PA.—H. A. Loeb, Frederick W. Meyers, Gilbert P. Smith, Walter C. McIntyre, T. Carpenter Smith, Edwin R. Keller.

PITTSBURG, PA.—Geo. R. Mathieu, Robt. A. M. Steel, J. M. G. Fullman, W. I. Patterson, W. J. Snyder, Jr.

PORT HURON, MICH.—D. J. Stevenson.

ROCHESTER, N. Y.—Rudolp Schmidt, T. H. Green.

SCHENECTADY, N. Y.—James F. Burns.

ST. LOUIS, MO.—Edw. T. Cooke, F. E. Newberry, Chas. J. Sutter, F. B. Adam, Wm. Hand, Wm. A. Corrao.

SYRACUSE, N. Y.—Jas. Hilton.

TOLEDO, OHIO.—H. W. Christian, Emil Grah, F. D. McCall.

TROY, N. Y.—Marshall L. Barnes.

UTICA, N. Y.—W. H. Morton.

WASHINGTON, D. C.—E. C. Graham.

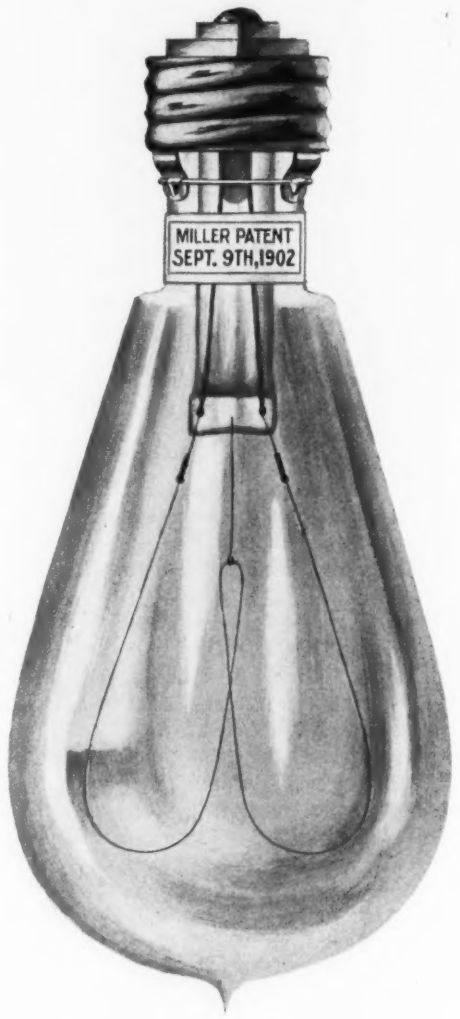
WORCESTER, MASS.—F. P. Coghlin.

A Large Electric Locomotive.

A dispatch from Schenectady states that the General Electric Company has completed an electric locomotive which is said to be the largest in the world. It was built for the Baltimore & Ohio Railroad Company for use in the Baltimore tunnel. The locomotive weighs 180 tons and is designed to haul freight trains weighing 1,500 tons up a 1½-per-cent. grade. Its capacity is 2,000 hp, and it is fitted with the multiple unit system of control, there being a controller at each end of the cab. The locomotive is made up of two units each weighing 80 tons, and is so arranged that any number of units may be coupled together. Each unit has eight 42-in. drive wheels, making 16 wheels in all.

The Miller Incandescent Lamp.

The accompanying illustration shows an incandescent lamp which is being placed upon the market by the Missouri American Electric Company, St. Louis, Mo., one of the features of which is a detachable base. The base consists of a porcelain insulating button and a cap or sleeve with the usual socket thread. The sleeve has three ears,



INCANDESCENT LAMP WITH DETACHABLE BASE.

and a wire passing around these, as shown in the illustration, securely fastens the base to the bulb. By this means the base is held against lateral rotation, and against longitudinal withdrawal by the wire strapping the lugs below a moulded shoulder of the bulb. When the filament is burned out, the neck of the lamp is cut below the sleeve, thereby enabling the stem which carries the filament to be pulled out. A new filament may then be mounted and the neck fused together at the point of cutting. The original bulb may be used or a new bulb fused on, as desired.

Among the advantages of this base is that the removably attached sleeve does away with the use of cement or plaster of paris; and not

only is a much stronger attachment made to the bulb, but there is no porous material present to gather dirt and moisture.

New Canal for Boston Edison Company.

At a hearing held before the Massachusetts Harbor & Land Commission on July 15, President C. L. Edgar, of the Edison Electric Illuminating Company, of Boston, outlined a plan for taking cold water from Boston Harbor by the construction of a new canal 10 ft. deep and about 500 ft. long, for the company's new South Boston station. The new plant is to be equipped with ten or twelve large steam turbines at the outset and will be the principal central station in the entire Boston district.

Mr. Edgar stated that in order to bring in this water cold it will have to be taken from the nearest deep channel, which is that reserved, off the company's land at L and First Streets, South Boston. The canal will be from 30 to 75 ft. wide, and the amount of dredging will vary from 6 to 10 ft. The company plans to adopt a bulkhead line for its whole water frontage on the line of the section filled in during 1902. The canal will extend from the present line of the reserved channel to this bulkhead line, and from there three tunnels, two of 8½ ft. diameter and one 10 ft. in diameter, will extend to a point beneath the station. These tunnels will be set in concrete and their mouths will be protected from floating rubbish by coarse racks of wood. There will be two openings for each tunnel in the proposed sea wall. Two of these tunnels will be for the intake of cold water, the duplication being intended to forestall any shut-down of the plant for repairs or cleaning; and the third will be for the outlet of water heated by condensation. To separate the outflowing water, which will have a temperature of about 90° Fahrenheit, from the incoming cold water, a wall will be extended diagonally outward between the mouths of the inlet and outlet tunnels in such a way as to divert the outflow.

Large screens for removing dirt and rubbish from the intake will be located at a short distance inside the sea wall. These will be in duplicate for removal without interrupting the work of stoppage of foreign substances. Manholes will be located still further within the sea walls. The tunnels are to be set in concrete, and cost from $200 to $300 per running foot. The level of the water will be artificially reduced at the station end of the canal, and will flow in from the harbor by gravity.

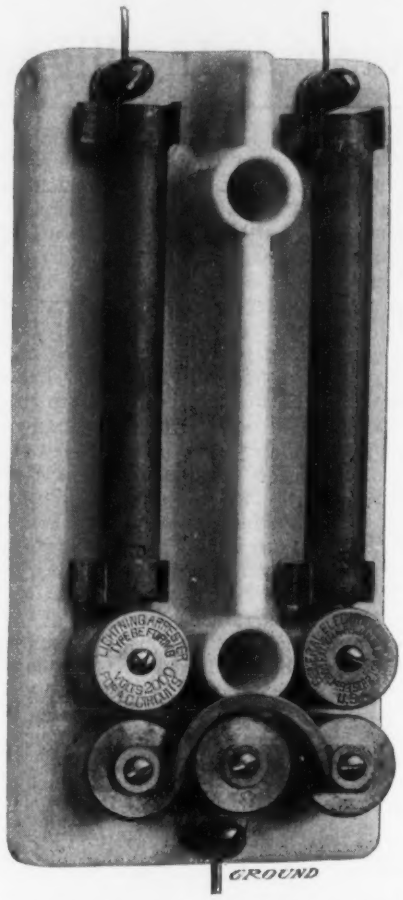
A New Development in Lighting Arresters.

Whenever alternating-current circuits contain both inductance and capacity in appreciable quantities, high voltages are likely to exist which endanger the insulation of the whole system. Such abnormal voltages are especially likely to occur in lines containing a combination of underground and overhead circuits.

The General Electric Company is now supplying alternating-current lightning arresters so designed as to protect against lightning and at the same time to act as a safety valve with reference to high voltages due to causes other than lightning. These high-voltage conditions in a great many cases may not be recognized by the central station manager unless they are brought to his attention by the frequent breaking down of insulation, and even then the troubles are often ascribed to other causes. The strains very often produce pin-hole punctures in the insulation of underground cables and thus relieve themselves temporarily; they may, therefore, remain unnoticed for a number of months until the insulation becomes very much impaired, ultimately resulting in a complete break-down.

It is very difficult to detect the existence of these excessive voltages with switchboard instruments commonly in use. In the first place, most voltmeters are installed on potential transformers. When these abnormal pressures exist, the wave is of enormous high frequency and will not appear on the secondary side of the transformer due to the fact that the eddy current set up in the iron by the high frequency is so great as to dampen out the wave and prevent its reappearance on the secondary side; but it is difficult to measure this pressure even with such instruments as electrostatic voltmeters installed directly across the high-pressure wires. This is because the wave is of short duration and its integrated value is so small and the time element of the moving mechanism of the instrument so large comparatively that the instrument will not record the disturbances. Practically it has been found that only spark-gaps of some form of wavemeter which records instantaneous value is of any service whatsoever for such measurements.

The new lightning arrester known as the "Bultiplex" performs the multi-function of protecting against lightning, resonance or



ALTERNATING-CURRENT LIGHTNING ARRESTER.

other high-voltage disturbances on the line. The arresters are installed directly across the lines, the center of the arrester being connected through an additional installation of arresters, so proportioned that there are the same number of gaps from either line to line as from line to ground.

Letters for Electrical Signs.

Metal letters for electric signs have the great advantage of taking a fine, glossy surface when coated with enamel colors that reflect the light from the lamps distributed about the letters. With a given number of lamps, a much larger and more effectual display may be made by using metal instead of wooden letters, and the former are not objectionable to fire underwriters. The letters keep their good appearance and finish quite a long time, and unlike wooden letters, do not crack, warp or shrink. Their advantage over the fire-enamel sheet steel signs is that the enamel colors do not chip and crack like fire-enamel does, when changing the temperature; moreover, they can be re-coated any time, while a fire-enameled surface, when once chipped, can never be repaired. The coated galvanized sheet steel signs are, although rigid, light in weight, thus saving transporation cost, and can be hung with less trouble and expense.

The Haller Machine Company, Chicago, manufactures as a specialty, metal letters for electric signs in sizes from 6 inches to 15 feet in height. The face of the letters is finished usually in white; the sides in red or other colors. The complete signs of the Haller Machine Company have a metal back ground, finished in smaltz. A raised metal frame around the sign and embossed metal ornaments in gold leaf finish, make a sign also very attractive in the day time.

The same company has introduced a new appliance for electric signs, consisting of an automatic sign dimmer which changes the sign or part of it, alternately or in rotation, from bright light to dark, and back again. This device may be used in connection with any existing sign of any size and shape, without necessitating a change of wiring.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was firmer than for sometime past, the closing rates being 4½@5 per cent. for 60 days and 5@6 per cent. for 90 days to six months. There was liquidation on an extensive scale in the stock market early in the week, and weakness developed which at times showed more or less demoralization. The public did not seem to be attracted by the lower level of prices. In the middle of the week, however, the heavy liquidation ceased, and there was better support and prices rallied somewhat toward the close. There was a severe drive at Amalgamated Copper, which carried it down to the lowest price on record and arrested the improvement in the general market. The reduction in the dividend of Amalgamated Copper resulted from the demoralization in the copper trade, which followed the abandonment by the Amalgamated Company of its attempt to maintain the price of the metal at 17c. per lb. All of the tractions and electric stocks suffered heavy declines in sympathy with the general market, and all, with the exception of Western Union, reached the lowest figures of the year. Brooklyn Rapid Transit lost 3½ points, closing at 51⅛, and Metropolitan Street Railway closed at 118½, being a loss of ⅝ point, 117 being the lowest figure of the week and of the year. General Electric dropped to 157, but rallied and closed at 165½, this being a net loss of 7½ points, while Westinghouse common closed at 170½, a net loss of 19½ points, and preferred at 176, a loss of 21⅞ points. Western Union was quite steady throughout the week, closing at 83½, a loss of ⅛ point, and American Telephone & Telegraph after dropping to 129¾, closed at 130, this being a loss of 2 points. Following are the closing quotations of July 21:

NEW YORK.

	July 14.	July 21		July 14.	July 21
American Tel. & Cable	77	77	General Electric	170¼	162
American Tel. & Tel.	127	130⅛	Hudson River Tel.	..	..
American Dist. Tel.	26	25	Metropolitan St. Ry.	118¾	115⅛
Brooklyn Rapid Transit	52	46⅛	N. E. Elec. Veh. Trns.	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	15	15	N. Y. E. V. T. Co.	5	4⅜
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1	1	Western Union Tel.	83	82⅛
Electric Vehicle	7	5	Westinghouse com.	..	170
Electric Vehicle pfd.	13	13*	Westinghouse pfd.	..	170

BOSTON.

	July 14.	July 21		July 14.	July 21
American Tel. & Tel	128⅛	150¼	Western Tel. & Tel. pfd.	90*	85
Cumberland Telephone	..	..	Mexican Telephone	1⅛	1⅝
Edison Elec. Illum.	242	239	New England Telephone	128¾*	123
General Electric	173	162	Westinghouse	..	85
Western Tel. & Tel.	13	12	Westinghouse pfd.	..	88⅛

PHILADELPHIA.

	July 14.	July 21		July 14.	July 21
American Railways	..	..	Phila. Traction	95¾	96¼
Elec. Storage Battery	60	55*	Phila. Electric	5⅞	5¾
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	8¾	8¼	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	July 14.	July 21		July 14.	July 21
Central Union Tel.	..	..	National Carbon pfd.		92
Chicago Edison	147	..	Northwest Elev. com.	..	..
Chicago City Ry.	185	185*	Union Traction	4	3⅛
Chicago Tel. Co.	..	..	Union Traction pfd.	30	30
National Carbon	23¾	23			

*Asked.

LOUISVILLE RAILWAY EXTENSIONS.—It is noted from Louisville, Ky., that arrangements have been completed for raising $3,000,000 for new lines and betterments of the Louisville Railway and to capitalize the equities in the common stock. To do this a holding company will be incorporated in New Jersey under the title of the Louisville Traction Company. It will have common capital stock to the amount of $12,000,000 and $2,500,000 5 per cent. non-voting preferred stock. Of the common stock, $7,000,000 will be exchanged for the $3,500,000 of Louisville Railway common stock and $500,000 will be distributed as a 20 per cent. bonus to the holders of the $2,500,000 old preferred stock. The new preferred stock will be exchanged for the old, share for share. When the holding company is organized, about September 1, $3,500,000 of common stock will be offered to the common stockholders of the old company at $55 per share, the first payment being $25. The remainder of the $55 will be called for as needed, the money being loaned to the street railway for extensions and betterments. The remaining stock will be sold from time to time as required. The stockholders are requested to deposit their stock, and will be given negotiable receipts until the new stock is issued. After the 5 per cent. dividend is paid on the $2,500,000 of the new preferred, all the road's net earnings above the fixed charges will go to the holders of the common stock. It is believed that dividends will be begun at the rate of 3½ or possibly 4 per cent. The road is earning 12 per cent. on the old stock now.

SECURITY OF TROLLEY BONDS.—With regard to the effect of franchise conditions on long trolley enterprises, the New York *Commercial Advertiser* makes some interesting and pertinent remarks as follows: In considering electric railroad securities, and in particular electric railroad bonds, it should be carefully noted whether the franchises and rights of way are perpetual or whether they are terminable. If the franchise is perpetual, then the same rules apply as apply to steam railroads, but if the franchises and rights of way are terminable a new element is introduced which must be considered when applying the income of the property to the capital account to determine the value of the securities. As an illustration we may consider the figures submitted for the Columbus, Delaware and Marion Electric Railroad, a trolley line forty-five miles long, connecting the three cities mentioned. This is an excellent property, viewed from a physical consideration of the plant, its roadbed, power and equipment complying with the best standards of the most modern practice. Its prospective earnings for the year 1903, based on the actual results of the last quarter of the calendar year 1902, are estimated by a conservative engineer to be as follows:

Gross receipts	$157,283
Operating expenses and taxes	86,506
Net earnings	$70,777
Interest on bonds	50,000
Surplus for stock	$20,777

On the face of things these bonds, which, by the way, amount to $1,000,000, for the forty-five miles of road, should be a fairly good bond; but if we consider the franchises we find that the company is limited to twenty-five years in Columbia, in Worthington, in Delaware and in Marion. It owns sixteen miles of right of way from Worthington to Delaware and about twenty-two miles from Delaware to Marion. At the end of less than twenty-five years from the present time the company will find itself owning two detached pieces of road sixteen and twenty-two miles long, and without terminals at either end, unless it is enabled at that time to have its franchises renewed. It is respectfully submitted that it is perfectly proper for stockholders to assume these speculative chances of renewing franchises at the end of twenty-five years. But the bondholders have a right to expect that the property be so financed as to earn interest on the bonds and sinking fund sufficient to retire the bonds within the limits of the franchises. According to the estimated income of this property, as given above, the earnings at the present time are at a rate sufficient to pay the interest on the bonds and retire one-half of the principal within the expiration of the franchise. In this respect, and in the respect that this company will actually own perpetually thirty-five to thirty-eight miles of operative railroad, this trolley line is in a much stronger position than many others in the Central West.

BOSTON EDISON CAPITAL INCREASE.—The Massachusetts Gas and Electric Light Commission has approved the petition of the Edison Electric Illuminating Company, of Boston, for permission to issue 20,000 shares of new capital stock for the purpose of adding to the equipment of the company and purchasing electric lighting plants located in Milton, Dedham, Canton, Natick, Framingham, Woburn, Somerville, Chelsea, Newton and Needham. In its decision the board states that it is of the opinion that the Edison Company would supply the entire district now covered by the several companies operating independently, with greater economy and efficiency; also, that the purchase of these companies by the Edison Company will place additional advantages at the disposal of the public, and insure a more satisfactory service than these districts have heretofore enjoyed. The par value of the shares is to be $100 each, and the market value of the new stock is fixed at $200 per share. If any shares remain unsubscribed for by the stockholders entitled to take them they may be offered at public sale.

DIVIDENDS.—The Minneapolis General Electric Company has declared a regular semi-annual dividend of 3 per cent. on preferred stock, payable August 1. There is talk that the dividend rate on Cincinnati Gas & Electric stock will be increased to 5 per cent. Three of the directors say that the change will occur within a year. The United Traction Company, of Albany and Troy, has declared its usual quarterly dividend of 1¼ per cent. The American Light & Traction Company has declared a regular quarterly dividend of 1½ per cent. on the preferred stock, covering the quarter ending June 30. The dividend is payable August 1. The Consolidated Trac-

tion Co. of New Jersey has declared a dividend of 1½ per cent., payable as registered June 30. The Chicago Edison Co. has declared a regular quarterly dividend of 2 per cent., payable August 1. The Western Telephone & Telegraph Company has declared a semi-annual dividend of $2 on the preferred stock, payable August 1, to stock of record July 18.

THE UNION TRACTION COMPANY OF INDIANA merged with the Indianapolis Northern Traction Company with nearly 300 miles of interurban lines in operation, and with a capital stock of $8,500,000 and a bond issue of the same amount, was on June 30 leased for 99 years to the Indiana Union Traction Company, which has a capital stock of $5,000,000, an authorized bond issue of the same amount, with $1,000,000 issued. Dividends on the stock of the leased company are graduated from ½ to 6 per cent., increasing 1 per cent. a year.

DEAL OFF.—It is reported that the proposed deal between the American Light & Traction Company and the United Gas Improvement Company, of Philadelphia, has been abandoned. Under the deal, the American Company was to have been leased to the Improvement Company on a 6 per cent. guarantee on the stock of the former.

ALBANY AND HUDSON BONDS.—Permission has been granted by the State Railroad Commissioners to the Albany & Hudson Railroad Company to issue $150,000 additional bonds for improvements.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the trade conditions *Bradstreet's* states that the prevailing summer weather helps crops, increases confidence in fall trade, and stimulates retail business. Speculation droops, but on the whole the tendency is in the direction of improvement. The money situation promises well, though predictions of higher rates in the future point to conservatism in the use of funds. The returns of railway earnings for six months, two-thirds of the country's mileage being represented, show a gain of more than 13 per cent. over the best on record, while roads thus far reporting for the first week of July show a gain of nearly 16 per cent. These figures confirm the claim that present business is the largest ever handled during a mid-summer period. The principal feature in trade reports is the better tone of advices from the Southwest. The reports from Texas are notably more favorable than they have been in recent years. From the Northwest the tone of advices is very good, and wholesale trade in the South is of good volume for the present stage of the season. Unprecedented activity is noted in the anthracite coal trade, and the shipments for six months are 68 per cent. in excess of a year ago, being nearly 32,000,000 tons. As to the crops, the outlook still favors next to largest recorded yields of wheat, corn and oats. The iron trade is quiet on the surface, but production and consumption are alike enormous, though pressure of the latter tends to ease in quotations from iron and steel. Copper is lower on alleged overproduction. Official prices were cut twice during the week, the last quotations being 13⅝ to 13¾c. for Lake and electrolytic and 13¼ to 13⅜ for casting stock. The business failures for the week ending July 16, as reported by *Bradstreet's*, aggregated 173 against 154 the week previous, and 174 the corresponding week in 1902.

GENERAL INCANDESCENT DEAL WITH GENERAL ELECTRIC.—An important step has been taken recently, as noted briefly in this department last week, by the General Electric Company in acquiring during the present month, or about three weeks ago, the control of the General Incandescent Arc Light Company, which under the vigorous direction of Mr. Samuel Insull and the efficient management of Messrs. Martin and Joseph Insull, has been brought to a commanding position in the field of electric light and power. It would appear that the opening arose out of the purchase by the Pennsylvania Railroad Company, on very advantageous terms to the sellers, of the splendid real estate of the General Incandescent Company, at the Thirty-fourth Street ferry of the Long Island Railroad. Mr. Insull had felt for some time that this was rather expensive property in the heart of a big city for factory purposes, but with wonted courage and foresight he held on, until now the big railroad system had to take it at a very high price for its tunnel and terminal developments in the vicinity. Meantime the General Incandescent Company, which has built up by steady work a big business in arc lamps, dynamos, motors, fans, meters, switchboards and other specialties, had to cast around for new quarters, but again a tempting proposition coming from the General Electric Company, Mr. Insull and other interests determined that it would be best to accept the proposition. The General Incandescent Company will be continued as heretofore, and its admirable specialties will be marketed under its name. It is reported that the factory will be removed to Pittsfield, but not much is being said at present on that point. The real estate goes into the hands of the Pennsylvania road on August 15. An interesting item of news that may be added here is the fact that the Cincinnati system has just awarded to the General Incandescent Company a further contract for its 4-amp. arc lamps, which have created so much interest during the past year. This will make a total of no fewer than 5,700 General Incandescent, or Hallberg 4-amp. arcs on the Cincinnati network.

BELL TELEPHONE INSTRUMENT STATEMENT.—The American Telephone & Telegraph Company's instrument statement for the month ended June 20 and since December 20 compares with previous years as follows:

	1903.	1902.	1901.
Gross output	87,608	96,653	96,300
Returned	42,189	41,741	34,221
Net output	45,419	54,912	62,079
Since Dec. 20:			
Gross output	600,064	589,109	469,923
Returned	235,141	226,267	194,569
Net output	364,923	362,842	275,354
Total outstanding	3,515,243	2,888,854	2,228,170

Many persons look upon the monthly instrument statements of the American Telephone & Telegraph Company as affording one of the best indices of trade conditions. To these the June statement, it is said, was a disappointment, being the poorest for the corresponding month in the past three years. A change in the system of collecting rentals from sub-companies was a factor contributing to the poor statement, since under the new system a large number of instruments held in stock by the several companies were returned to the lessors. Another adverse influence was the check of the canvass for new telephones in sections of the country where cheap telephones are being installed by the active and energetic independent companies. It is stated that for the year ended December 31, 1902, the parent company received less than $1 rental for each instrument against $14 a decade ago.

THE YEAR'S FOREIGN COMMERCE.—The foreign commerce of the United States for the fiscal year just closed aggregated $2,445,610,417, being the highest on record and an increase of $160,570,068 over the previous year. The increase over the fiscal year 1901 was $134,673,261; 1900, $201,186,151; 1899, $521,438,626, and 1898, $598,078,433. Imports in the year last named were valued at $616,049,654 and for the year just closed at $1,025,619,127, an increase of $409,569,573; the volume of exports in the meantime increasing only $188,509,960, or from $1,231,482,330 to $1,419,991,290. Compared with last year the value of the imports shows the enormous increase of $122,298,179, and the total, $1,025,619,127, for the first time in history, exceeds the billion-dollar mark. In the exports there was an increase of $38,271,889, but the greater increase in imports left a balance of trade in favor of the United States of but $394,372,163 aaginst $478,398,453 for the previous fiscal year. The growth in importation, which is the most striking characteristic of the year's commerce, is very largely in materials for use in manufacturing. Only eleven months' figures are yet available in such detailed form as to show the increase by great groups, but the figures of the eleven months ending with May show that articles in a crude condition for use in manufacturing, increased sixty-two million dollars or about 20 per cent. as compared with the corresponding months of last year; articles partially manufactured for use in manufacturing increased four million dollars or about 5 per cent.; articles manufactured and ready for consumption increased eighteen million dollars or about 13 per cent., and articles of voluntary use, luxuries, etc., increased fourteen million dollars or about 12 per cent., while articles of food and live animals increased fifteen million dollars or about 8 per cent.

MORE EQUIPMENT FOR SYDNEY POWER PLANT.—Because of the Sydney City & Suburban electric traction system, operated by the New South Wales government, having lately been operated with but little reserve of power, the State Cabinet has given authority to the railway commissioners to expend $500,000 in securing further equipment for installation in the Ultimo central power station. The conversion of the various lines will have to wait until the new machinery arrives. The first installation in the power house consisted of four 1,200-hp Allis engines, direct-connected to General Electric generators. These were supplemented August last by three 2,000-hp engines, also of Allis build, and direct-connected to General Electric generators. At the same time the foundations were built for three more engines and generators of the latter capacity. These are now urgently required. Two of them will be held in reserve. The boilers installed in the plant are of Babcock & Wilcox build. The structural steel for the power house was shipped by the American Bridge Company. It was the first contract ever let for

steel frame construction in Australia. The specifications now issued call for reciprocating or turbine engines. Full details can be secured by addressing the agent general for New South Wales, 9 Victoria Street, London, S. W. Tenders will be received in Sydney up to September 12.

CONCHOS RIVER POWER TRANSMISSION SCHEME.—Further particulars are to hand regarding the Conchos River power transmission scheme, to which some reference has already been made in these columns. The Conchos River Power Company has appointed as consulting engineers the John F. Kelly Engineering Company, 149 Broadway, New York. The contracts for equipment, etc., will be awarded through this firm. George F. Hardy, 309 Broadway, is the hydraulic engineer. William Stanley, of the Stanley interests, and Frank H. Wright, president of the Stanley Investment Company, are primarily interested in the project. The latter gentleman is president of the Conchos River Power Company. About 3,200 hp is to be transmitted from the plant to be built at La Joya, on the Conchos River, to the City of Chihuahua, 80 miles distant, and 46 miles to Parral. The energy will also be utilized for the supplying of light and power to several mines in the vicinity. A dam of rip-rap construction will be built. The power house equipment will include four turbine water wheels to operate under a head of 125 ft. The wheels will be of 800 hp each and are to be direct-connected to 600 kw, three-phase, 60-cycle alternating-current water turbine type generators. Direct-current exciters of 2,400 kw will also be installed. The transmission line is to operate at 40,000 volts. Contracts are expected to be awarded next month.

THE ARKANSAS VALLEY INTERURBAN RAILWAY COMPANY has been chartered to build an electric railroad from Wichita, Kan., southeasterly to Oxford, thirty-seven miles, thence east to Winfield, ten miles; west to Wellington, fourteen miles, and south to Geuda Springs, twelve miles, and to Arkansas City, ten miles farther—a total distance of eighty-three miles. The main power station will be at Oxford, where it is believed there is sufficient water power to run the whole line, unless it may be a month or two in summer when they will possibly need a small steam plant as an auxiliary. The water power is to be taken from the Arkansas River, which is estimated to furnish 2,200 horse-power at ordinary low water, and 1,500 horse-power is the amount estimated to run the road. The company is capitalized at a million, and most of the stock is subscribed. Local capital alone is interested so far. O. A. Boyle is president; William Allison, vice-president; J. E. Howard, secretary; C. L. Davidson, treasurer, all of Wichita. The headquarters of the company is Wichita. They expect to carry both passengers and freight, and to furnish electric light and power for the towns along the line. Mr. Boyle is general manager, and is pushing preparations as fast as possible toward completion of specifications, which it is hoped will be ready in a few weeks.

THE HELENA LIGHT AND TRACTION COMPANY is building a new power-house at Helena, Mont., which will be equipped with Westinghouse apparatus throughout, a portion of which has recently been ordered from the Westinghouse Electric & Mfg. Co., the remainder having been in use for some time. The electrical equipment consists of two 75-kw, direct-current generators, each to be direct-coupled to a 100-hp, type C induction motor; two 15-hp, motor-generator sets; nine 10,000-volt transformers—six of 150 kw and three of 125-kw capacity; also two 175-kw rotaries. Three 150-kw and three 125-kw transformers will be equipped with a face plate for obtaining different voltages from the transformers, this dial being connected to the low tension circuit in such a manner as to give variation of voltage between 2400 an 2050. Seventeen low tension leads are brought out from the secondary winding, one lead directly connected into the line and another lead connected to the spark gap, the remaining fifteen connected to the regulator face plate outside of the transformer case. This allows the purchaser to secure proper voltage regulation for extreme variation in load without changing the voltage at the Missouri River Company's station, fourteen miles distant.

ST. LOUIS FAIR INTRAMURAL RAILWAY.—A contract has been closed with the General Electric Company for fifty-one complete car equipments, each equipment to consist of four motors of 40-hp each, and each to be supplied with the latest train control apparatus. The train control is to be similar to that in use on the Manhattan Railway in New York City, the elevated roads in Chicago, and New York's underground electric railway. The trains for the Intramural Railway are to consist of three cars each, making seventeen trains in all for the road. They are to be equipped with air brakes by the National Electric Company, of Milwaukee, and will be of the well-known Christensen type especially adapted for train control service. The first ten trains are to be in operation on or before September 1 next. The contract with the General Electric Company was made through Mr. George D. Rosenthal, the St. Louis representative of the company, and the contract with the National Electric Company by Mr. J. D. Maguire.

ELECTRICITY IN HOISTING.—A new plan for gradually eliminating the horse is an application of electricity for the hoisting and conveying of dirt where excavations are made for the foundation of a building. A recent device carries a platform or carriage suspended on a stout cable, there being mounted on the platform a motor with two sets of frictional gearing, trolley wheels and the necessary apparatus for controlling the current. One of the friction gears propels the carriage on the cable or wire, the other raises and lowers the buckets of earth. It is a pretty operation and does away with the old method of backing a dump cart down a steep incline into the excavated place from which the carts were loaded by hand. In operation the new plan, as shown in Brooklyn, N. Y., empties the buckets as fast as four laborers can fill them.

SALES OF STREET RAILWAY APPARATUS.—Among recent sales of street railway apparatus, the Westinghouse Traction Brake Company reports an order from the Los Angeles Railway Company for 80 street car air brake equipments with motor-driven compressors, to be fitted to new high-speed cars built by the St. Louis Car Company. The Company has also lately closed contracts for the following motor-driven compressor air brake outfits: 16 to Oakland Transit Company, Cal.; 17 to North Shore Railroad Company, San Francisco, Cal.; 12 to Indianapolis & Northwestern Traction Company; 16 to Indiana Railway Company, South Bend, Ind.

MICHIGAN TELEPHONE.—At Detroit, Mich., on July 15, Judge Swan, in the United States Circuit Court, ordered the sale of the plant of the Michigan Telephone Company to satisfy a mortgage held by the Old Colony Trust Company, of Boston. The property will be bid in by a syndicate representing the bondholders of the company, and it is understood that they have made arrangements to take care of a claim of $600,000 held against the Michigan company by the Central Trust Company, which is the trustee of the bonds of the Detroit Telephone Company, which was absorbed by the Michigan company. No date was set for the sale.

MEXICAN CAR BUILDING PLANT.—Construction work is to begin immediately on the Mexican Car & Foundry Company's plant in Mexico City. Isaac M. Hutchison, of Mexico City, who represents the interests in the southern republic of the St. Louis Car Company, A. L. Ide & Sons, etc., is president of the enterprise. The company will build electric cars as well as those suitable for steam roads. The initial buildings, equipment, etc., will call for an expenditure of $1,000,000 Mexican currency. It is anticipated that the plant will be ready to commence building cars before the end of the year.

INTERNATIONAL STEAM PUMP.—The report of the International Steam Pump Company for the year ended March 31 shows a surplus of $506,154 after dividend payments, $262,402 increase over 1902. Arrangements have been made to extend the company's business in Europe by consolidating the European company with other companies and factories. This consolidation has opened up an important outlet for the production and has practically solved the difficulties arising from tariff conditions.

THE NEWCASTLE FORGE AND BOLT COMPANY, of Newcastle, Pa., is installing in its plant the following electrical apparatus, which has been purchased from the Westinghouse Electric & Manufacturing Company: two engine-type generators, of 75 and 100 kw capacity respectively, which will be operated by engines furnished by the Erie City Iron Works; seven 30-hp, direct-current motors, complete with rails and pulleys, and a three-panel switchboard with the usual auxiliary apparatus.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., through its Portsmouth, N. H., agents, Messrs. W. T. Trafton & Son, has recently closed a contract with H. C. Hewitt & Co., of Portsmouth, N. H., for a number of six-glower Nernst lamps. These lamps have been installed in Hewitt & Co.'s business house and are giving entire satisfaction.

CHICAGO EDISON COMPANY.—An official of the Chicago Edison Company says that the company is supplying its limit in electric power. The company has about twenty stations, among which are eight generating plants. Business was never better. Marshall Field is the company's best individual customer.

CHICAGO TELEPHONE.—The Chicago Telephone Company's net gain of telephones in the city and country during June was 2,649, making the total in use 90,729. President Wheeler says the company will have 100,000 in use by the end of the current year.

LIGHTING PLANT FOR JAPAN.—The Kinshu Railway Company, of Japan, is about to let contracts for the complete equipment of an electric lighting plant to be erected at Wakatmatsu. The equipment will be purchased in this market.

General News.

THE TELEPHONE.

PRESCOTT, ARIZ.—The Prescott Electric Company operates a Eureka switchboard of 450 drops and gives service to 425 subscribers at Prescott and 100 at Jerome. It also has 250 miles of toll line, which reach small towns and mining camps throughout the country.

GRANGEVILLE, IDAHO.—The telephone system between this city and Buffalo Hump has been completed, and is now in operation.

ROSEVILLE, ILL.—The Roseville Telephone Company has recently increased its switchboard capacity and now operates a 200-drop board, with 300 subscribers and 15 miles of toll line. A large addition to the subscriber list is expected.

SARDINIA, IND.—The Sardinia Telephone Company has a 25-drop board and 45 telephones in use; with 11 miles of toll line.

SHELBYVILLE, IND.—A wire of the Mutual Telephone Company fell across one of the wires of the traction company on July 1, and a switchboard, containing 200 lines, was burned out.

WHITESVILLE, IND.—The Whitesville Co-operative Telephone Company has a 50-drop board and 90 subscribers, with 24 miles of toll line. The system consists mainly of farmers' lines.

INDIANAPOLIS, IND.—The New Long-Distance Telephone Company has completed and opened a long-distance line to Louisville, Ky., and also to French Lick, St. Louis and other points in the South and West.

VINCENNES, IND.—The Farmers' Mutual Telephone Society has organized to build a line from Russellville to Vincennes. The company will arrange for the Knox Telephone Company to handle its business in Vincennes.

MT. VERNON, IND.—The Posey County Home Telephone Company has a switchboard capacity of 1,500 drops using 400 at present; has 300 subscribers and 30 miles of toll line. Construction work is not yet completed.

NEWTON STEWART, IND.—The Newton Stewart & Paoli Telephone Company started business on a small capital two years ago, and has twice increased it. A 100-drop board gives service to 75 country subscribers, and 50 in town. More are daily coming in.

ELWOOD, IND.—Conditioned on the sanction of the transfer by the Union Central Telephone Company, E. C. Van Auker, of this city, has purchased the telephone system. The company secures long-distance connection through the Central Union, and for this reason the purchaser desires the sanction of that company.

LOGANSPORT, IND.—At a meeting of the stockholders of the Home Telephone Company on July 10 George W. Seybold was elected president of the company to succeed Theodore Thorwood, resigned. George W. Seybold, J. A. Seybold, Engnihardt Schmidtt, M. F. Mahoney and J. G. Powell were elected directors. H. W. Porter, F. B. Wilkinson, Solomon Brandt and Engnihardt Schmidtt were elected directors of the Cass County Telephone Construction Company.

INDIANAPOLIS, IND.—The Central Union Telephone Company makes the following report to the State Tax Board for the year ending April 1: Capital stock, $3,587,000; 4,159.5 miles of poles, against 4,042.5 miles last year; 55,808.75 miles of wire, against 43,217.25 for last year; 40,224 business telephones, against 46,336 for last year, a decrease of 6,112; 74,773 residence telephones against 61,422 for last year, an increase of 3,251. The net earnings are given at $173,706, against $224,526 for the previous year.

BEDFORD, IND.—The Union Home Telephone Company has been organized and incorporated to build lines and operate a number of exchanges in Lawrence and Jackson Counties. The company has a capital stock of $25,000, and will endeavor to extend and develop rural telephony to its greatest point of utility and perfect service in this field. Two rural systems have already been purchased by the new company. These will be combined and will give the company nearly 200 miles of rural lines. John A. Hartman and Frank Vance, J. C. Monteith, Seymour; W. H. Brown, Hintonsville, and G. C. Dudley, of Ohio, are promoters.

MUNCIE, IND.—The four-month strike of the Electrical Workers' Union against the Central Union and the Delaware and Madison County Telephone Companies at points throughout Madison County was formally declared off on July 11. It is given out that the companies agreed practically to all the demands of the strikers except the discharge of non-union men now in their employ, but agreed that all men hired in the future shall be union men. Superintendent Cline, of the construction department of the Central Union held out against any compromise with the strikers, but the absolute necessity of immediate repairs and improvements and the inability to secure sufficient non-union men for the purpose rendered prompt action necessary.

KOKOMO, IND.—The City Council has granted a forty-year extension of franchise to the Citizens Telephone Company on condition that all be laid underground and the poles removed from the streets. The company has accepted. The Citizens' Company operates a 3,000-line board and has 2,500 subscribers while the Bell Company has 400 subscribers. During the year ending June the company increased its capital stock from $25,000 to $100,000; increased its pole line from 26.5 miles to 56.5 miles; its wire from 77 to 141 miles; the number of its business telephones from 350 to 371; its residence telephones from 650 to 1,179; its gross earnings from $13,500 to $24,341, and its net earnings from $4,486 to $11,446. The company charges $2 per month for business telephones and $1.25 for residence telephones.

INDIANAPOLIS, IND.—The regular quarterly distribution of prizes for the long-distance operators of the New Telephone Company has been made. Hilda Canady was winner of the $25 prize; Addie Temple of the $15 prize, and Alice Milton of the $10 prize, in the competition for the highest average of efficiency and application to work during the last quarter. The cash prizes are awarded each quarter on the records made by the operators in attendance, lost calls, efficiency and deportment, the highest record possible being one hundred. By the lost call record is meant the number of long-distance calls that the operator is forced to abandon on account of inability to find the person called. It is stated that the more efficient operators will search by wire for a person called all over a town in order that a lost call may not be registered against her. It has been found that the efficiency of the long-distance operators of the New Company has been increased since the eight-hour order, and the plan of awarding prizes went into effect.

EVANSVILLE, IND.—The filing of a suit in the Superior Court by ex-Judge R. D. Richardson, to enjoin the City of Evansville from taking stock in the proposed Municipal Telephone Company, or from exercising any rights as stockholder under the subscription already made to the municipal telephone company, has produced quite a sensation. Richardson seeks also to enjoin all city officers as well as directors of the Municipal Telephone Company from taking any steps pursuant to orders or contracts made by or between the city and telephone company, on the ground of invalidity of any such transaction between the city and the municipal company. The complaint alleges the scheme to be illegal; that it would entail a heavy debt on the city by making it liable financially for all indebtedness if the company fails, and contends that the franchise to the streets in time would be bought by outside parties for little or nothing. The estimated cost of the municipal plant is $300,000 and the money to be paid in is $175,000. The city is not able to advance the money, he alleges. The officials of the municipal company claim that the Cumberland Company is back of the suit, and the plan is to hinder the letting of the contract for the new plant.

SCHALLER, IA.—The Schaller Telephone Company has a 100-drop board with 10 extra for country lines; 190 subscribers, 100 being in the country.

SLOAN, IA.—The Sloan Telephone Company has one of the largest exchanges, using a Clark Automatic system, and finds it very satisfactory. With a 75-drop board it gives good service to 79 subscribers.

MARINE CITY, MICH.—The Marine City Telephone Company operates a 200-drop board and has 100 subscribers.

MORRICE, MICH.—The Union Telephone Company uses 25 drops of a 100 board and has 25 subscribers at $12 and $15 per year.

MEMPHIS, MICH.—The Michigan Telephone Company, the only one doing business here, intends to have a rural exchange with about 50 subscribers. It now has a 15-drop board with five subscribers and six miles of toll line.

NORTH BRANCH, MICH.—The Michigan Telephone Company contemplates a large increase of business and extensions in many directions in the farming districts. It has an 80-drop board and 60 subscribers, besides eight miles of toll line.

KALAMAZOO, MICH.—The Citizens' Telephone Company, whose capital is $250,000, has 1,400 subscribers. The lines are all copper metallic and extend over the whole country, keeping the company in close touch with the outside world.

ZUMBRATA, MINN.—The Zumbrata Telephone Exchange has 200 switchboard capacity and 183 subscribers. There are 20 miles of toll line, and an increase is projected.

VERNDALE, MINN.—The Verndale Telephone Company operates a 100-drop switchboard, of which 60 are installed, and 60 subscribers. Rural lines are to be extended considerably in the near future.

COLUMBIA, MO.—The Columbia Telephone Company operates a 600-drop board and has about 800 subscribers, with 50 miles of toll line. The company will build 50 miles more of farmers' lines.

ABERDEEN, MISS.—The Citizens' Long Distance Telephone & Telegraph Company has reached the ultimate (220 drops) capacity of its switchboard and is having another installed to meet the demand of waiting subscribers. There are now 239 subscribers and about 200 miles of toll line. A line to Memphis, Tenn., is projected. Rates are 25 cents for five minutes; $18 and $24 per annum. The offices of this company are at Columbus, Miss.

ALBANY, N. Y.—The State Line Telephone Company has been incorporated with a capital of $1,000,000. No principal business office given. It is to connect New York and Buffalo by telegraph as well as telephone. Directors are Wm. Engert, George Engert, Chas. W. Andress, Robert P. Lyon, Daniel A. Nesbitt, Egbert A. Reynolds, of New York City and Henry N. McKay, of Brooklyn.

ASHEVILLE, N. C.—The proposed merger of the Bell and Asheville Telephone companies at Asheville is creating a great amount of discussion, and a committee has been appointed to see if another company will take the field at the present rates.

RALEIGH, N. C.—The retail grocers' association of Raleigh, in an effort to reduce the cost of telephone service, has adopted the Bell and Raleigh telephones, excluding the Interstate service. The matter, however, seems to be still unsettled.

CLARKSVILLE, TENN.—The Home Telephone Company, of Clarksville, has completed its line to Guthrie, Ky. Other extensions are also being made.

JEFFERSON, N. D.—The Jefferson Telephone Company reports quite a bright outlook, as subscribers are coming in. At present there are 30 with a 9-drop board. The company also has 25 miles of toll line.

HECLA, S. DAK.—The Social Telephone is exactly what its name implies. Each subscriber becomes stockholder on payment of $35, and has free use of the line; outsiders pay 25 cents for five minutes' use. The switchboard capacity is 12 drops, but is to be increased. There are 200 subscribers and 75 miles of toll line

PENDLETON, ORE.—The plant of the Pendleton Telephone Company has been purchased by John Endicott of this city. It is his intention to immediately extend and improve the system. The line at present extends from here to Pilot Rock, Alba, Ukiah, and Lehman Springs.

ELECTRIC LIGHT AND POWER.

SYLACAUGA, ALA.—The Sylacauga Water & Light Company has been incorporated with a capital of $25,000 by L. T. Yoder, of Pittsburg, Pa., and other citizens of Sylacauga.

CLIFTON, ARIZ.—A. F. Johns, of San Francisco, Cal., is making a survey for the construction of a power plant to be located on Blue River, for the transmission of electrical energy to Clifton and Morencia.

FT. ROSECRANS, CAL.—Bids are wanted Aug. 6 for an electric plant at this post. Address Maj. J. H. Wiliard, Corps Engineers, U. S. A., 518 Bradbury Building, Los Angeles, Cal.

CORONA, CAL.—The Corona Gas & Electric Company has been organized with a capital of $50,000, by M. W. Findlay, F. Cooper, M. Terpenning, and others, to construct a gas and electric light plant.

WASHINGTON, D. C.—The Norfolk Industrial Company and the Montgomery Power Company, the two companies which have franchises to develop power at Great Falls, have consolidated, and the new concern is now known as the Potomac Power Company of Maryland and Virginia; capital $110,000. Horace G. Williams, president; Clifford L. Pullen, vice-president, and William E. Stokes, secretary.

ST. AUGUSTINE, FLA.—The Council is negotiating with a company to establish an electric plant, at a cost of $50,000.

ASHLEY, ILL.—The city council has passed an ordinance calling for the issuance of municipal bonds to the amount of $5,000, the proceeds to be used in erecting a city electric plant.

ALTON, ILL.—The Alton City Council, at its meeting July 11, entered into a ten-year contract with the Alton Railway, Gas & Electric Company, for the lighting of the city. The city will be allowed 32 more arc lights at the old price.

RICHMOND, IND.—Bertrom & Storrs, of New York, N. Y., have purchased the plant of the Richmond Light, Heat & Power Company, and will make extensive improvements.

INDIANAPOLIS, IND.—Joseph McWilliams & Co., of Indianapolis, have secured the contract for the construction of a power plant, at a cost of $78,000, for the Central Indiana Hospital for Insane, at Indianapolis.

PRINCETON, IND.—The Princeton Lighting Company has purchased the Oakland City Electric Light Company plant, paying $10,000 for it. Extensive improvements will be made and some new machinery installed.

WABASH, IND.—The citizens of this city are strenuously opposing the municipal light proposition and the council will likely reject it. An estimate furnished by an electrical expert places the original expenditure at $41,000, and the expense of operating and repairs at $7,000 annually. Adding to this depreciation of property with $2,000 interest on bonds, makes the question of such serious import as to warrant the citizens in opposing the scheme.

HARTFORD CITY, IND.—The three dynamos to be used in the American Window Glass Company's factory have arrived and are being installed. They will be belted to the shaft of a gas engine of 150 horse power. The dynamos are of 25, 75 and 220 volts and will furnish power and light for the immense plant. The factory is being equipped for electric power, because it is the intention to operate the blowing machines by electricity as well as all other departments.

NOBLESVILLE, IND.—The Noblesville Hydraulic Company has been incorporated, with a capital of $100,000, to construct a wooden dam across White River between Potter's bridge and Conners dam in Hamilton County. The dam is to provide a millrace for the hydraulic company's power house, which will be erected north of city for generation of electrical power for Noblesville. W. C. Beardsley, South Bend, is engineer in charge of the work. Theodore D. Layman, of Indianapolis, is one of the incorporators.

ROCK VALLEY, IA.—It is stated that D. A. McKellar will construct an electric light plant here.

DES MOINES, IA.—The contract for laying eight miles of conduits for putting the overhead wires of the Edison Electric Light Company underground in the business district has been awarded to George King. The company also awarded to the Des Moines Clay Works the contract for the conduits.

HOPKINSVILLE, KY.—John H. Bell, Jr., of Hopkinsville, has secured a franchise for an electric light plant.

MADISON, ME.—The estimated cost of an electric light plant for Madison is $42,000. Dr. W. G. Sawyer is chairman of the committee.

PORTLAND, ME.—The Omaha Electric Light & Power Company has been organized at Portland, capital, $3,500,000. Ernst L. Carr, of Melrose, Mass., and Charles H. Tolman, of Portland, are among the incorporators.

ROCKVILLE, MD.—Joseph Schreiber, of Baltimore, is reported to have secured the contract for lighting the town with electricity at $1,500 per year. He will install new machinery in the power house.

BOSTON, MASS.—Penal Commissioner John B. Martin has awarded to Edwin C. Lewis, of Boston, the contract for furnishing and setting up a complete electric system in the new building for the House of Correction, Deer Island, for $23,336, and to Hodge Boiler Works, of Boston, for three horizontal tubular boilers for the same building at $3,586. The lowest bid opened July 1 by the Board of Trustees of Insane for installing an electrical system in the new building for women at Austin Farm, was that of the Lord Electric Company, at $14,250.

NECAXA, MEX.—The Mexican Light & Power Company is constructing a plant at Necaxa. Its first installation will comprise six 7,000-hp impulse wheels, direct-connected to 5,000-kw generators. The available head is 1,250 feet. In connection with this work it is proposed to construct a storage reservoir with a capacity sufficient to operate the plant four months independent of any flow in river. Jas. Ross, Toronto, Ont., is president. F. S. Pearson, 29 Broadway, New York, will award the contracts.

MARQUETTE, MICH.—It is proposed to expend about $15,000 in improving the municipal electric light plant.

MORRIS, MINN.—A 15-year franchise has been granted to the Fowler Electric Company.

LANESBORO, MINN.—Thompson & Habberstad have secured the contract for erecting the electric light plant, to take the place of the old one. An entire new system with new machinery for a 220-volt lighting system will be installed; also a new waterwheel, flume and connections of steel.

ST. LOUIS, MO.—The new $33,000 municipal lighting plant in the City Hall building was satisfactorily tested June 22. The entire plant will consist of six generators and three 185-hp engines. Two engines and four generators have been installed. The plant will light the City Hall, Four Courts and City Jail, Court House and Fire Engine House No. 6, and run the new elevators in the City Hall at a saving to the city of over $20,000 yearly.

PARADISE, NEV.—A. Pasquale, of this city, has announced his decision to install an electric plant on Martin Creek, eight miles from here, the power to be generated at the dam of the Paradise Mining Company. Power will also be furnished for the town of Winnemucca.

ANDOVER, N. B.—Bids will be received July 25 by the Andover and Perth Electric Light Commissioners for installing an electric plant for the villages of Andover and Perth, including the development of the water power, building power house, supplying and setting wheel, supplying and setting poles with cross arms, supplying and installing electrical plant. C. H. Elliott is secretary.

MT. HOLLY, N. J.—The Marlton Light, Heat & Power Company has been incorporated, with a capital of $10,000, by W. H. Zelly, H. B. Dunphey, and others.

NEWARK, N. J.—The United Electric Company of New Jersey has secured the contract for lighting the city for five years (1,860 lights) at $95 per light per year.

SANTA FE, N. M.—It is reported that the Capital Light & Power Company will soon begin the construction of an electric plant on Pecos River, the power to be transmitted to Santa Fe, Las Vegas and Albuquerque.

SCHOHARIE, N. Y.—The power plant of the Middletown and Schoharie Light, Heat & Power Company was destroyed by fire on July 2.

ALBANY, N. Y.—The Korona Heat & Light Company, of New York, has been incorporated; capital $100,000. Directors: David Ogilvy, H. H. Hayden and J. E. Walker, New York.

MANCHESTER, N. Y.—The Ontario Light & Traction Company, of Canandaigua has secured the contract to light the streets by electricity for ten years, the price to be $15 per light for the first year, $14 for the second year, and $13 for the remaining seven years.

MT. AIRY, N. C.—Bids will be received by the Mayor until July 27 for certain supplies incidental to the construction of the electric light, water works and water power plants. John W. Hays, of Petersburg, Va., is the engineer.

ASHEVILLE, N. C.—It is reported that Mr. George W. Vanderbilt will soon begin the construction of a model manufacturing city between Hendersonville and Brevard, N. C. The work will involve a complete system of water works, electric lighting, heat and power.

CASSELTON, N. D.—Bids will be received August 3 by B. D. Youells, City Auditor, for an electric light plant.

WILLIAMSBURG, OHIO.—The citizens have voted to issue electric light bonds.

JERMYN, PA.—The Household Electric Light, Heat & Power Company, Jermyn, has been incorporated with a capital of $6,000.

MAYFIELD, PA.—The Independent Electric Light, Heat & Power Company, of Mayfield, has been incorporated with a capital of $6,000.

GLEN CAMPBELL, PA.—The Electric Light, Power & Manufacturing Company has been organized, with S. J. Smith, president, and C. W. McCrady, Secretary.

HOUSTON, TEX.—It is reported that the Houston Electric Company has decided to expend about $100,000 in improvements to its power house.

LAREDO, TEX.—C. C. Pierce, of Laredo, is reported interested in the construction of an electric power plant on Rio Grande River, about 25 miles above Laredo.

BEAUMONT, TEX.—The Beaumont Light & Power Company has been incorporated with a capital of $600,000. Incorporators: W. A. Myrick and W. J. Crawford, of Beaumont, and C. H. Beauchamp, Jr., of Dallas. The company will probably purchase the plant of the Beaumont Ice, Light & Refrigerating Company.

SEATTLE, WASH.—The City Council has passed an ordinance directing the Comptroller to secure bids for $590,000 bonds for establishing or buying a municipal lighting and power plant.

JANESVILLE, WIS.—The Janesville Electric Company will construct an extensive power plant here.

GRANTSBURG, WIS.—W. I. Gray & Co., of Minneapolis, Minn., have secured the contract for an electric light plant, for $6,695.

SHEBOYGAN, WIS.—The Sheboygan & Elkhart Railway & Electric Company has applied to the city for a franchise to operate an electric lighting plant.

WEYAUWEGA, WIS.—The Weyauwega Electric Light Company, of Weyauwega, has been incorporated, capital $20,000. Incorporators: W. H. Weed, W. E. Hinchey and F. E. Phillips.

PORT WASHINGTON, WIS.—The Water Works Committee has recommended the construction of a combined water works and electric light plant, to be located in the gravel pit, the water to be supplied from artesian wells.

THE ELECTRIC RAILWAY.

PRESCOTT, ARIZ.—The Prescott Electric Company has commenced the construction of a street railway system in this city. When completed it will extend to Fort Whipple and will furnish transportation for the mines in that section.

LOS ANGELES, CAL.—The big deal between E. H. Harriman and H. E. Huntington for control of practically all the electric roads in Los Angeles County has been closed by the payment of $1,500,000 and the transfer of the Los Angeles Traction Company to Huntington. This, it is stated, ends all the threats of war between the two interests.

DECATUR, ILL.—The sale of the Decatur Traction & Electric Company's property has been effected by a syndicate of Eastern capitalists represented by W. B. McKinley, of Champaign, purchasing the entire issue of $250,000 in capital stock for $200,000. The system has been bonded for $212,000. This makes the total valuation of the plant $412,000. The capitalists represented by Mr. McKinley are now building interurban systems that will eventually be joined and make an electric railway from Danville through Champaign and Decatur to Springfield, thence to St. Louis.

CHICAGO, ILL.—It is announced that the Lake Street Elevated Railroad securities committee has secured sufficient deposits of stock to warrant its proceeding with its reorganization plan. Pending the preparation of such a plan the committee has adopted resolutions extending the time for depositing the securities to Sept. 15, 1903.

RICHMOND, IND.—The Eastern Indiana Electric Railway Company has commenced its survey of the proposed line from Richmond to Portland, Ind.

FORT WAYNE, IND.—It is stated that the Fort Wayne & Southwestern Traction Company, which is now in the hands of a receiver, will probably be restored to the stockholders within a few days. The property was placed in the hands of S. L. Nelson, the general manager, as receiver, at the instance of the National Bank of North America, New York, which held a $100,000 note of the company, and which sued to prevent its claim becoming a junior lien under a mortgage about to be executed. The bank has dismissed the case, the company having adjusted the claim to its satisfaction, and Mr. Nelson, it is said, will soon retire as receiver and resume his duties as general manager. The company has no floating debt.

DUBUQUE, IA.—The Dubuque & Western Railroad Company has filed articles of incorporation. Peter Kiene, of Dubuque, is president. The Eastern Securities Company, of New York, is backing the project.

WORCESTER, MASS.—The Railroad Commissioners have approved the extensions of the Boston & Worcester Street Railway Company in Eastern Avenue, Framingham; of the Framingham, Southboro & Marlboro Street Railway Company in Worcester Street, Framingham, and of the Hampshire & Worcester Street Railway Company, in Warren.

BOSTON, MASS.—The Boston Transit Commission has opened bids for the construction of the last section of the tunnel which will connect East Boston with the city proper. Eight bids were received, ranging from $125,000 to $229,170. The successful contractor will have until Dec. 20 to complete his work, and this will not include the laying of the tracks.

EXETER, MASS.—The Epping, Brentwood & Kingston Street Railway, chartered with an authorized capital of $200,000, has been organized. The directors are Russel H. Fellows, of Brentwood; Levi W. Bartlett and L. Waldo Collins, of Kingston; D. Frank Fellows, of Brentwood; John Scammon, of Exeter; Mr. Perrin, J. A. Edgerly, W. S. Goodridge and R. R. Morris, of Epping. Russel H. Fellows was elected president.

FALL RIVER, MASS.—The Tiverton & Seaconnet Street Railway incorporators—the company proposing to build from New Bedford to Horse Neck and thence through Little Compton and Tiverton to Fall River—have formed a corporation with the following directors: A. S. Pennock, B. W. Carlow, N. L. Sheldon and Henry M. Brett, of Boston; George T. Howard, of Little Compton; Job Wordell and Frank Grinnell, of Tiverton.

SPRINGFIELD, N. H.—At the annual meeting of the Springfield Electric Railway Company the following directors were elected: E. C. Crosby and C. W. Wyman, of Brattleboro; F. S. Coolidge and M. A. Coolidge, of Fitchburg, and W. W. Brown, of Springfield. The directors elected E. C. Crosby president and general manager; M. A. Coolidge, vice-president and treasurer, and Allyn J. Crosby, superintendent.

GLEN FALLS, N. Y.—Plattsburg men have formed a syndicate which has quietly secured the rights of way for an electric road up the Saranac Valley from that city to Clayburg, a distance of 20 miles.

ALBANY, N. Y.—The State Board of Railroad Commissioners has approved of a change of name of the New York and North Shore Railway Company to the Long Island Electric Railway Company.

JAMESTOWN, N. Y.—The Chautauqua Traction Company has been granted authority by the State Railroad Commission to build an electric railway 14 miles long from Lake Wood to Mayville. The company has a capital of $500,000.

BROOKLYN, N. Y..—Plans have been filed in the Building Bureau at Long Island City for new car houses to be erected at the corner of DeKalb and Covert Avenues, Ridgewoood, by the Coney Island & Brooklyn Railroad. The building will be of brick, and will cover a space of 105 ft. by 700 ft.

COLUMBUS, OHIO.—The Lancaster, Logan & Nelsonville Traction Company, of Logan, has been incorporated, with a capital of $10,000, by A. Magoon, J. W. Jones, D. A. Rannells, F. M. McKay and F. E. Pierpont.

NEWARK, OHIO.—J. F. Shorontz, Edward Kibler, Edward H. Everett, Frank Moore and F. E. Elliott have applied for incorporation papers at Columbus for the Newark, Martinsburg & Mount Vernon Traction Company.

CINCINNATI, OHIO.—The stockholders of the Indianapolis & Cincinnati Traction Company have voted to increase the capital stock of the company from $1,500,000 to $2,000,000, and have authorized a bond issue of $4,000,000. The company's line will be double track. The right of way as far as Connersville has practically been secured, and the contract for the construction of the grade has been let. Rails for the line have been purchased from the Cambria Steel Company, and the ties have been contracted for from the Gray Tie Company, of Evansville.

HAZLETON, PA.—Surveys are being made for the new electric railway between Hazleton, Weatherly and Mauch Chunk. F. W. Larned, of Wilkesbarre is president.

YORK, PA.—The Gettysburg Battlefield Electric Railway, which was recently sold by the Gettysburg Transit Company to Philadelphia capitalists, will be extended to Westminster, Md.

PITTSBURG, PA.—An electric railway system is to be built between Avalon and Freedom, in the Ohio Valley. It is the project of officials of the Pennsylvania Railroad.

WILKESBARRE, PA.—A trackless trolley line has been projected to run from Buttermilk Falls by way of Lake Winola and the East Mountain Lithia Spring to Factoryville, a distance of about 9 miles. A power house is to be erected at the Falls.

HOMESTEAD, PA.—An electric railway is to be built from Hays Borough south to Currys Station, a distance of about 6 miles. The right of way has been secured by E. W. Curran, of Homestead. The capital of the new company is $36,000. The officers of the company are: President, F. N. McKinney, of Pittsburg; secretary, F. W. Curran, of Homestead.

DOYLESTOWN, PA.—The Bedminster Railway Company, capital $15,000, has been chartered. The incorporators are Isaac R. Rosenberger, of Colmar, president; Lewis Keller, Dr. N. S. Nonamaker, John S. Bissey and John H. Nickel, of Bedminster; Charles R. Rosenberger, of Colmar; Harry J. Shoemaker and Samuel A. Hellyer, of Doylestown; Aaron Kratz, of Plumsteadville, and L. P. Muthart, of Allentown.

FREELAND, PA.—The Freeland Electric Coach Company has been organized to operate a trackless trolley line from this place to Upper Lehigh, St. Johns, Eckley, Sandy Run and other towns. The officers are: President, Hugh Malloy; vice-president, Albert Goeppert; secretary, S. J. Neuberger; treasurer, M. Schwabe; directors, Hugh Malloy, A. Goeppert, S. J. Neuberger, M. Schwabe, A. Oswald, of Freeland, and Harry W. Davis, of Wilmington, Del.

SCRANTON, PA.—The Scranton Railway Company has entered into a three-year contract with Division No. 168 of the Amalgamated Association of Street Railway Employees, in which provision is made for every contingency that may arise in the relation of the company and its employees. It went into effect July 20, and remains in force until April 1, 1906. The agreement provides for a board of five arbitrators, one of whom shall be a neutral. Motormen and conductors are to receive 18 cents an hour for the first year, 19 cents for the second, and 20 cents thereafter.

HARRISBURG, PA.—A charter was granted July 9 to the Central Pennsylvania Traction Company, capital $2,100,000, which will take over the lines of the Harrisburg Traction Company by August. The directors are T. C. Calder, Edward Bailey, James M. Cameron, E. Z. Wallower, A. G. Knisely, H. A. Kelker, Dr. W. H. Seibert, James Russ, George W. Reily, B. E. Myers, E. E. Walz, S. F. Dunkle, Harris Cohen, E. C Felton, E. W. S. Parthemore. Edward Bailey is president; W. G. Calder, secretary and treasurer, and Frank Musser, general manager. It is stated that the property of the Harrisburg & Mechanicsburg Electric Railway Company will be acquired by the new company. New machinery will be installed at the power plant and new rolling stock secured.

COLUMBIA, S. C.—The City Council of Columbia has passed an ordinance providing separate seats on street cars for whites and blacks. Since the passage of the ordinance the negroes of the city have virtually determined upon a boycott against the street railway company.

NASHVILLE, TENN.—The Tennessee Western Railway Company has been incorporated, with $100,000 capital stock, to construct a railway from Humboldt to Alamo, a distance of about 40 miles. The incorporators of the company are W. H. Skevington, J. H. Connor, Albert Akers, James Brown and Bradley Walker.

NORFOLK, VA.—The Chesapeake Transit Company has increased its capital stock from $500,000 to $630,000. The additional capital is to be used for the construction of more cars and other equipment.

RICHMOND, VA.—The striking street car men announce that they have secured subscriptions to stock aggregating $40,000 and will purchase a large number of automobiles capable of carrying twenty-five persons each. These will be put on the streets paralleling the lines of the street car company.

MORGANTOWN, W. VA.—Surveys have been started on the proposed electric railway from Morgantown to Granville. The Union Utility Company is having the surveys made. It will build the line under the charter recently granted the Fairmont, Morgantown & Cheat River Trolley Company, and they will operate it together.

FOND DU LAC, WIS.—The Fond du Lac & Northwestern Railway Company has been incorporated to construct and operate an interurban railway from Fond du Lac to Manitowoc and Appleton. The incorporators are W. H. Phillips, H. W. Wilson, Franklin Phillips, J. E. McMullen and F. H. Sweet.

LA CROSSE, WIS.—The La Crosse & Black River Electric Railroad Company, which proposes to build between La Crosse and Black River Falls, has made application for a franchise. The construction of the road will begin in the fall, and it will cost $1,000,000. The road is incorporated temporarily at $500,000.

MARINETTE, WIS.—The Marinette and Menominee street railway and lighting companies will be formally combined. The capital stock is to be increased from $300,000 to $560,000 to make improvements. The name of the consolidated corporations is to be the Menominee & Marinette Light & Traction Company, with general offices in Menominee.

NEW INDUSTRIAL COMPANIES.

THE WILLIAM EBBITT ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated to own telephone lines, appliances and other devices; capital $150,000.

THE MANHATTAN SWITCHBOARD COMPANY, of Newark, N. J., has been incorporated; capital, $500,000. Incorporators: Charles Loeffler, August Schramm and Carl H. Van Baur.

THE SHAW ENGINEERING & MANUFACTURING COMPANY, of Newark, N. J., has been incorporated with a capital of $100,000. Incorporators: H. M. Shaw, J. C. Blevney, F. M. Shaw.

THE NASSAU TRANSPORTATION COMPANY, of New York, has been incorporated with a capital of $50,000. The directors are J. J. Hall and C. I. Hall, of New York, and James Hall, of Brooklyn.

LEGAL.

MANHATTAN ELEVATED THIRD TRACK.—A decision in the matter of the third, or express, track on the West Side lines of the Manhattan Elevated Railway has been handed down by Supreme Court Justice Truax, who holds that though Henry B. Auchincloss, the plaintiff, is not entitled to have the extra track removed, yet he is entitled to receive both fee and rental damages, amounting in his case to $9,000 for fee and $8,000 for rental. Mr. Auchincloss objected to the third track on the ground that it was unauthorized by law, and contended that the building of the express track in short sidings was only an evasion of the statute which prohibited a continuous third track. When the suit was first brought Justice Bischoff dismissed it, but the Appellate Division reversed him and ordered a new trial, holding that the construction of the track was unauthorized, and imposed an extra burden on the plaintiff's property. Justice Truax in his decision says that it is unnecessary to consider whether the third track was a siding, as had been claimed, or not.

PERSONAL.

EARNEST MCCLEARY.

MR. EARNEST McCLEARY, whose portrait is here shown, is the new president of the National Electrical Contractors' Association, succeeding Mr. Eidlitz, who has been so active and efficient in that capacity. Mr. McCleary is a member of the firm of McCleary and Colquitt, of Detroit. He has been association director for the state of Michigan, and one of the most popular men in the national organization. He not only possesses a thorough training as an electrical engineer, but has a knowledge of law that has been of inestimable value in all sessions of the directors of the association. He has been actively interested in the national body since its organization, and was early recognized as a leader among its members. It was largely through his efforts that the large exhibition of electrical apparatus was held in connection with this session of the convention at Detroit.

MR. G. M. GEST, the expert subway contractor, was in New York the early part of this week looking after some of his large contracts.

MR. M. R. FISTER, of the Home Telephone Company, Elkhart, Ind., has resigned to accept a position with the Stromberg-Carlson Telephone Mfg. Company at Rochester, N. Y.

CAPT. LEONARD D. WILDMAN, Signal Corps, has been ordered to proceed to New London, Conn., on business pertaining to the electric installations of the Signal Corps.

MR. FREDERIC NICHOLLS, ex-president of the National Electric Light Association, has been elected vice-president of the Toronto Street Railway Company in the place of James Ross, resigned.

MR. G. MARCONI will, it is said, return to this country in August to follow up the work here, when one improvement to be introduced, it is said, will be the abolition of the present tall towers and wire masts.

MR. W. VAN WHITALL has withdrawn from the firm of Gilbert Wilkes & Co., Denver, of which he was one of the organizers. His holdings in the company were purchased by Mr. Woolfington. Mr. Whitall will take up other lines of work for the future.

MR. J. D. MAGUIRE, of the National Electric Company (successor to the Christensen Engineering Company), Milwaukee, informs us that his company has just closed the contract for the World's Fair Exposition at St. Louis for the entire air brake equipments for their intramural road. It was a very keenly contested contract, and the company feels quite elated over its success.

MR. T. H. BAILEY WHIPPLE, who has been associated with the Sawyer-Man Electric Company as assistant to the second vice-president, succeeds Mr. C. W. Rice in the Nernst Lamp Company. Mr. Whipple, who was formerly connected with the Jandus Electric Company, of Cleveland, Ohio, is a man of wide experience and acquaintance in the electric lighting field, and eminently fitted for the position which he assumes.

MR. PHILIP DAWSON, the well-known civil and electrical engineer, presided at the Savage Club dinner in London recently, when affairs as well as the entrees had a decidedly electrical flavor. The broad sheet menu had an excellent portrait of Mr. Dawson in the center, surrounded by other sketches of well-known men, and of electric railway apparatus, humorously depicted. In one corner a Yerkes car is shown butting a Morgan car off the track.

MR. HENRY HALLBERG, for a few years past the arc lighting expert of the General Incandescent Arc Light Company, has just been offered and has accepted the responsible position of general superintendent of the electrical department of the Cincinnati Gas & Electric Company. He will take over these new duties after August 15, when a large amount of important development work awaits his attention, in which his familiarity with the technical affairs of this large corporation will help him.

MR. CALVIN W. RICE, second vice-president of the Nernst Lamp Company, of Pittsburg, Pa., has announced his resignation from the Company, to the universal regret of his business associates, who found in him that combination of executive ability and personal attraction so much to be desired. Since May, 1902, Mr. Rice has held the position of second vice-president, to which he later added the duties of sales manager. To his efforts is due in a large measure the success of the company, the past year having been a particularly prosperous one.

MR. H. H. VREELAND, President of the Interborough Rapid Transit Company, New York, was at last reports in Holland. Referring to his desire to banish business from his mind and take a complete rest, he stated, while in London, that he had hard work to get himself down from 100 to zero. "Now that I feel that I have reached that point, I am making a steady effort to keep from rising again. I am not making a study of street railways; in fact, I am avoiding the subject."

BARONESS HELMHOLTZ.—Considerable space is given, says the New York *Evening Post,* in Prof. Leo Königsberger's new three-volume biography of Helmholtz to the wife of that eminent man of science. Thanks to her intelligence and personal charms her home was for a long time the social headquarters of the savants in Berlin, most of whom were intimate friends of Helmholtz. Among his English friends the warmest were Lord Kelvin, Faraday and Tyndall. He used to visit Tyndall in his picturesquely situated villa near the Aletsch glacier, in Switzerland, and like that eminent Englishman he used to combine scientific study of the Alpine phenomena with climbing and recreation. When Edison went to Heidelberg in 1889 to exhi
to the German men of science, Helmholtz was formeost among those who extended to him a cordial greeting.

OBITUARY.

MR. E. W. BLISS.—We regret to note the sudden death of Mr. Eliphalet W. Bliss, the head of the great mechanical and manufacturing concern that bore his name. He died late on Tuesday afternoon, July 21, at his country home, Owl's Head, Bay Ridge, from heart disease, following a week's illness due to indigestion. Mr. Bliss was born at Cooperstown, N. Y., on April 12, 1836. His school education ended with his sixteenth year, and he then served five years' apprenticeship in a machine shop. He worked as a journeyman machinist in Syracuse and Meriden, Conn., and served through the Civil War with the Union army. After the war he went to Brooklyn, where he established himself in business. He founded the manufacturing concern of E. W. Bliss & Co., and the United States Projectile Company, being President of both corporations. He was also identified with many other enterprises. Mr. Bliss was an enthusiastic yachtsman and clubman. He was a member of the New York, Atlantic, Larchmona and American Yacht Clubs. He was also a member of the Union League and Metropolitan Clubs, and of Lafayette Post No. 140, G. A. R. He leaves a widow, Mrs. Lane, his daughter, and several grandchildren. It is stated that he died while talking over with his wife the plans of a holiday trip to Germany, to be undertaken in a fe wdays.

EDUCATIONAL.

AMERICAN SCHOOL OF CORRESPONDENCE.—As the result of his presence at a reception tendered by Dr. Gunsaulus, president of Armour Institute, to the students of American School of Correspondence, Mr. William E. Curtis, of the Chicago *Tribune,* was so impressed with the earnestness of the three thousand students who attended, that in the Chicago *Record-Herald* he devoted several columns to the subject of correspondence school education, which he commended in warmest terms. Prof. Elliott, of Harvard, while recently visiting the school, was also greatly impressed at the work being done, and expressed himself amazed at the scope, thoroughness and standard of the instruction. The character of the instruction papers is illustrated by the fact that they are used at Columbia University and by the United States Government at the Army Post Schools.

TULANE, UNIVERSITY, LA.—Prof. Douglas Anderson, of the department of electrical engineering, Tulane University of Louisiana, New Orleans, writes us as follows: Our engineering courses here are so organized that the four-year students in mechanical engineering get only one complete year in electrical engineering, there being no special course in that subject. A student desiring to take further work in and to make a specialty of electrical engineering has to come back for an additional year or two. Of this latter class Mr. George Howe completed this year a two-years' post-graduate course in electrical engineering and received the degree of mechanical engineer. He is now at Schenectady in the students' course of the General Electric Company and expects to return to Tulane next year as an instructor in the physical laboratory. As far as I know, none of the regular four-year graduates of this session has gone into electrical work, but several of them expect to return next session in order to continue their work in electrical engineering.

Trade Notes.

VARLEY DUPLEX MAGNET COMPANY requests that its mail be addressed to Providence, R. I., as well as Phillipsdale. It appears that letters properly addressed to Phillipsdale, R. I., go almost invariably to Philadelphia, and in some instances are sent to the Philippines. Hence correspondents will greatly facilitate their own affairs by adding Providence.

THE NATIONAL ENGINEERING COMPANY, 214 Terrace, Buffalo, N. Y., has been organized to do business as engineers, agents and contractors. As engineers it is prepared to furnish mechanical designs of machinery, power plants, transmission systems, shops, mills, etc.; as agents it will take charge of installation work for other companies, and as contractors will build and install plants.

THE MISSOURI-AMERICAN ELECTRIC COMPANY announces in a pamphlet the coming of the Miller incandescent lamp and describes the very complete preparations that have been made for its manufacture. A number of special machines never heretofore used will be employed in the manufacture of this lamp, and it is stated that the filament plant is the most up-to-date in the United States.

ROBBINS & MYERS COMPANY, Springfield, Ohio, has resolved to adopt for its well-known dynamo and motor apparatus the designation "The Standard," and will apply it to all its product after September 1, 1903. This term has, indeed, long been applied by it to the familiar Robbins & Myers fan motors, but will now cover the whole range up to the largest size of dynamo sent out from its factories.

NERNST LAMPS IN JEWELRY STORE.—A recent test of the Nernst lamp made at the instance of Mr. F. O. O'Neill, jeweler, of Philadelphia, showed an average consumption per hour of 88 watts, about half that required for incandescent lamps giving the same amount of light. This economy, with the superior quality of light given by the Nernst lamp—an especially desirable feature in the illumination of jewelry or other stores requiring a brilliant light showing true color values—led to the installation of twenty Nernst lamps.

PELTON WATER WHEELS.—The latest edition of the catalogue of the Pelton Water Wheel Company, San Francisco, includes 88 pages, bound in stiff covers. The pamphlet has rather the character of a technical treatise on high-head hydraulic engineering than of a trade bulletin. In a section under the head of "General Information," a concise resumé is given of the main features of this branch of hydraulic engineering, and in other parts of the pamphlet are many valuable hydraulic tables, such as for calculating the horse power of water, the loss of head by pipe friction, wire measurement, etc.

ELECTRICITY IN MINING.—The great part which electricity plays in mining is well illustrated by a recent publication of the Jeffrey Mfg. Company, of Columbus, Ohio. This consists of a 128-page catalogue relating to mining machinery, a greater part of which is devoted to electrically operated coal cutters and coal drills, and electric motors for mine and surface haulage. Every form of these appliances is illustrated in excellent wood cuts printed on half tone paper. The latter part of the catalogue is descriptive of electrical generating machinery, switchboards, mining pumps and details of electrical mining installations.

THE STANDARD ENGINEERING COMPANY, Cleveland, Ohio, has been incorporated to conduct a general engineering and contracting business, succeeding the business which was recently conducted under the firm name of the Standard Engineering Company, of Detroit, Mich. The officers are F. A. Little, president; George L. Wells, vice-president; A. J. Wells, secretary; J. Tufel, treasurer; W. E. Davis, consulting electrical engineer, and Henry L. Payne, consulting chemist. The company is prepared to do all kinds of engineering, including the construction of complete electric railway systems, electric power and lighting plants.

LIVE STEAM WATER PURIFIERS AND HEATERS.—The Hoppes Manufacturing Company, Springfield, Ohio, has issued a new edition of its catalogue on live steam water purifiers, exhaust steam feed water heaters, steam separators, oil eliminators and exhaust heads, and also a separate pamphlet on steam separators, oil eliminators and exhaust heads. Both of these publications are well printed on coated paper and illustrated by extremely good half tone cuts. In addition to illustrations showing all of the details of the various apparatuses, are cuts which show the condition of the trays when ready for cleaning; these details will particularly impress upon the minds of the steam users the great value of transferring from a boiler to a special apparatus easily cleaned, the deposit of impurities from feed water.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 14, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

732,730. TELEPHONE-RINGING DEVICE; James I. Gemmill, Cleveland, Ohio. App. filed Feb. 24, 1902. (See page 144.)

732,734. TELEPHONE RECEIVER; John S. Goldberg, Chicago, Ill. App. filed Feb. 14, 1903. (See page 143.)

732,795. SUB-STATION TELEPHONE-CIRCUIT; Almon B. Stetson, Malden, Mass. App. filed March 31, 1903. (See page 143.)

732,874. AUTOMATIC CENTRAL-STATION TELEPHONE SYSTEM; Friedrich Merk, Berlin, Germany. App. filed May 31, 1902. (See page 143.)

732,915. GUARD FOR SPEECH RECEIVERS AND TRANSMITTERS; Samuel J. Ballard, Los Angeles, Cal. App. filed Oct. 14, 1902. (See page 143.)

732,931. TELEPHONE-SWITCHBOARD; Charles E. Egan, Chicago, Ill. App. filed May 1, (See page 144.)

733,021. TELEPHONE; Benjamin O. Fox, Milwaukee, Wis. App. filed July 11, 1902. (See page 144.)

733,271. ELECTRIC BRAKE; William B. Potter, Schenectady, N. Y. App. filed Jan. 30, 1901. An auxiliary source of current can be thrown into the braking circuit of the motors to hold the brakes after the motor has ceased to rotate.

733,296. TELEPHONE; Ernest Hugo Strauss, Chicago, Ill. App. filed July 14, 1902. (See page 144.)

733,305. ELECTROMAGNET; Isaac G. Waterman, Santa Barbara, Cal. App. filed June 24, 1902. A modification of 733,097.

733,343. ELECTRICAL APPARATUS FOR USE OF ULTRA-VIOLET RAYS; Frederick F. Strong, Boston, Mass. App. filed May 11, 1903. A vacuum tube having a discharge electrode and a lens transparent to ultra-violet rays, located opposite the electrode.

733,389. PROCESS OF REMOVING SILICA FROM COKE; Charles M. Hall, Niagara Falls, N. Y. App. filed Sept. 24, 1902. (See page 142.)

733,401. ALTERNATING CURRENT MOTOR CONTROLLER; Austin Kimble, Chicago, Ill. App. filed Jan. 26, 1903. The field magnet is in the main circuit while the armature current is supplied from the secondary of a transformer, the voltage being determined by the number of coils of the secondary thrown into circuit.

733,436. CLAMP FOR USE IN CONNECTION WITH SOCKET CARBON BRUSH HOLDERS; Oscar M. Stiegler, Boston, Mass. App. filed Nov. 8, 1902. A clip fitting the rear end of a carbon brush.

733,485. MEANS FOR THE CONTROL OF THE ELECTRICAL DRIVING OR REVERSIBLE ROLLING MILLS; Carl Ilgner, Breslau, Germany. App. filed June 25, 1902. An arrangement of a motor-dynamo in combination with a fly-wheel to prevent fluctuations of current due to the reversal of rotation of the rolling mill motor.

733,496. TROLLEY FOR ELECTRIC LINES; Kennedy Lyons, New Rumley, Ohio. App. filed March 5, 1903. A device to retain the wheel on the wire.

733,502. MEANS FOR PROTECTING THE EXPOSED OR LIVE PARTS OF ELECTRIC SWITCHES, CUT OUTS, ETC.; William McDevitt, Philadelphia, Pa. App. filed April 14, 1903. The base block upon which the switches are mounted, is built up of a number of blocks of various sizes and shapes, so arranged as to house the metal parts in grooves or chambers.

733,524. TROLLEY POLE GUIDE; Hezekiah O. Woodbury, Beverly, Mass. App. filed Oct. 13, 1902. A pair of horns arranged to be thrown upward to act as a finder for the trolley wheel.

733,549. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed March 25, 1903. A plurality of coils wound transversely upon a magnet core and symmetrically disposed with reference to an axis perpendicular to the pole face, whereby the armature will be prevented from chattering when the coils are traversed by an alternating current.

733,550. CONTROLLING DEVICE FOR ALTERNATING CURRENT MOTORS; David L. Lindquist, Yonkers, N. Y. App. filed March 25, 1903. The motor controls itself by the change of voltage in the secondary circuit from the period of starting to the attainment of full running speed, the voltage then decreasing from a maximum to zero.

733,551. ELECTRIC CONTROLLER; David L. Lindquist, Yonkers, N. Y. App. filed April 10, 1903. An induced current obtained from current fluctuations in starting, is used to control the cutting out of the starting resistance.

733,553. ELECTRIC CONTROLLER FOR HYDRAULIC ELEVATORS; Joseph W. Moore, Newton, Mass. App. filed Dec. 26, 1901. Instead of the usual pilot valve for operating the main valve of the elevator, it is proposed to use an electric controller acting directly on the main valve itself and capable of automatically controlling the same as well as being subject to control from the car.

733,556. SUBMARINE TELEGRAPHY; Alexander Muirhead, Shortlands, Eng. App. filed Dec. 27, 1898. Self-inductances serve to regulate the amount of "curb" required to produce the most rapid changes at the beginning of the cable and other self-inductances in shunt to the receiver and condenser, permit the steady current to pass while causing the rapid variations to operate the receiver.

733,560. PROTECTIVE ELECTRIC SWITCH BOX; August Sundh, Yonkers, N. Y. App. filed Feb. 20, 1901. Details of a switch box arranged to be inserted at any point in a conduit.

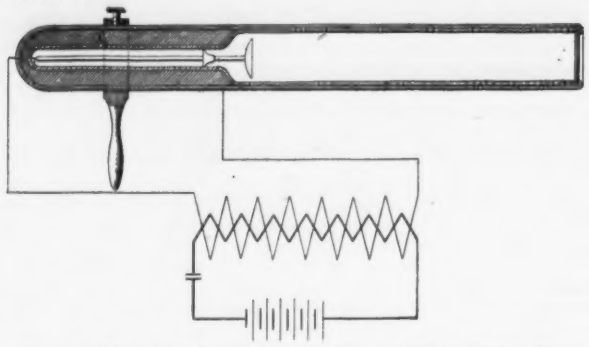
733,561. PRESSURE REGULATED SWITCH; August Sundh, Yonkers, N. Y. App. filed July 11, 1902. Details of an automatic switch adapted to be actuated by fluid pressure.

733,562. ELECTROHYDRAULIC CONTROLLER FOR ELECTRIC MOTORS; August Sundh, Yonkers, N. Y. App. filed July 11, 1902. Means whereby a relatively light current in a primary circuit is enabled to set into operation hydraulic mechanism of considerable power for operating the devices which immediately control the circuits of the motor.

733,563. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. The invention consists in means for producing a

compound magnetic circuit including a movable body, means for moving this body to reduce the reluctance in the circuit and other means for increasing the magnetic flux in said circuit simultaneously with the movement of the body.

733,564. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. A certain construction and combination of parts for a controller.



733,343.—Electrical Apparatus for Use of Ultra Violet Rays.

733,565. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. An electromagnet, a movable armature, a circuit closing device controlled by the magnetic field of said armature and caused to close circuit when said armature is moved into attractive proximity thereto, and means for reducing the current strength in said electromagnet after said circuit has been closed.

733,566. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. A switch designed to be certain and positive in its action and unaffected by vibrations and jars that occur on vehicles.

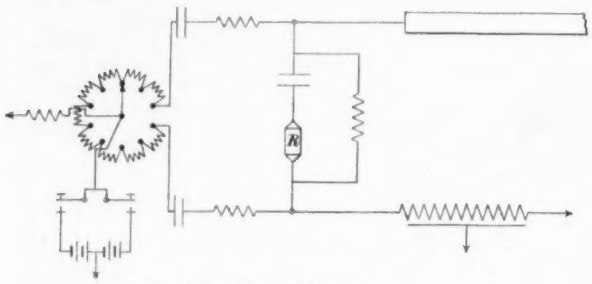
733,567. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. Consists of means for producing two magnetic fields, an armature movably supported in one field and actuated thereby to move into the other, and means controlled by the armature for neutralizing its actuating field upon the armature becoming subject to the holding control of the field into which it has been moved.

733,568. PIPE OR ROD COUPLING DEVICE; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. A clamp for the end of a pipe consisting of two semi-circular parts held together by bolts and having threads engaging with the end of the pipe.

733,569. BINDING POST AND CONTACT FOR ELECTRIC SWITCHES; William C. Tregoning, Hartford, Conn. App. filed April 23, 1903. A peculiar form of sheet metal clip secured to the top of a binding post.

733,578. PROCESS OF SMELTING METALS AND METAL COMPOUNDS; Georg Egly, Charlottenburg, Germany. App. filed Jan. 14, 1903. (See page 143.)

733,587. ELECTRICAL ROTARY PORTABLE MACHINE FOR CUTTING SUGAR CANE; ETC.; Stephen J. Hylton-Bravo, Hawthorn, Victoria, Australia. App. filed April 18, 1903. A circular saw driven by a motor located at its hub.



733,556.—Submarine Telegraphy.

733,602. METAL ANODE; Harry E. Starrett, Chicago, Ill. App. filed Dec. 19, 1901. (See page 142.)

733,609. PROCESS OF WINDING FLAT WIRE; Richard Varley, Providence, R. I. App. filed March 15, 1903. Flat ribbon-like wire in long continuous lengths is wound up into a single coil in the shape of a disk by winding it against the faces of a step and pulley, and afterwards removing the different sections and forcing them one over the other into the same plane.

733,610. RHEOSTAT; Wm. C. Yates, Schenectady, N. Y. App. filed Oct. 3, 1902. The resistance coils are embedded lengthwise in grooves containing insulating material, a portion of the coil projecting for contact with the switch arm.

733,619. TROLLEY CIRCUIT BREAKER; Charles P. Breese, Norfolk, Va. App. filed April 1, 1903. A mechanical connector for the insulated sections of a trolley wire in which the two ends of the conductor overlap each other so that the wheel in passing will always be in contact with at least one of the conductors.

733,627. POLARITY INDICATOR; Frank P. Cox, Lynn, Mass. App. filed Jan. 21, 1901. A polarity indicator comprising a polarized relay and two indicating lamps in connection with double break contacts bridged by the armature of the relay at its limits of vibration and connections for cutting in either lamp.

733,631. CONDUIT AND TROUGH FOR ELECTRIC CONDUCTORS; Thomas E. Devonshire, Chislehurst, Eng. App. filed March 3, 1903. A conduit built up of cement in which metallic net work is embedded.

733,633. FORM FOR WINDING ARMATURE COILS; William F. Frees, Schenectady, N. Y. App. filed Sept. 1, 1898. Details of construction.

733,637. DEMAGNETIZER; William J. Forster, Milwaukee, Wis. App. filed March 15, 1902. A convenient apparatus for demagnetizing watches, tools, etc.

733,667. AUTOMATIC GAS LIGHTING ATTACHMENT; Charles F. Mason, Dryden, N. Y. App. filed March 23, 1903. Details.

733,674. ARRANGEMENT FOR THE SUPPORT AND COOLING OF STATICAL OZONIZERS; Marius Otto, Paris, France. App. filed May 26, 1903. (See page 143.)

733,702. ELECTRICALLY OPERATED MUSICAL INSTRUMENT; George H. Davis, New York, N. Y. App. filed Nov. 9, 1896. Relates to the means for mounting and shifting the contact fingers which co-operate with the perforated music roll.

733,727. TROLLEY HEAD; Frederick V. Marsh, Mass. App. filed Aug. 22, 1902. The shaft of the trolley wheel is screwed into the end of the harp, the latter being in two pieces so that by swinging one of them around, it is unscrewed from the shaft and the wheel released.

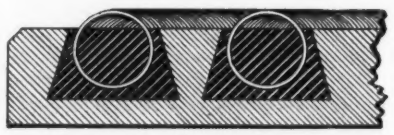
733,750. SIGNALING APPARATUS FOR ELEVATOR CARS; Charles A. Reiners, Chicago, Ill. App. filed April 17, 1899. The signal for a car approaching a landing is operated by two sets of circuits, one on the car, and the other on the shaft and landing. The circuits are automatically interconnected by attraction of the magnet on the car for an armature fixed in the shaft.

733,755. MEANS FOR PREVENTING BENDING STRAINS IN WIRES; Joseph J. Shickluna, Buffalo, N. Y. App. filed Oct. 28, 1901. The wire is provided with an annular spring portion which obviates bending strains.

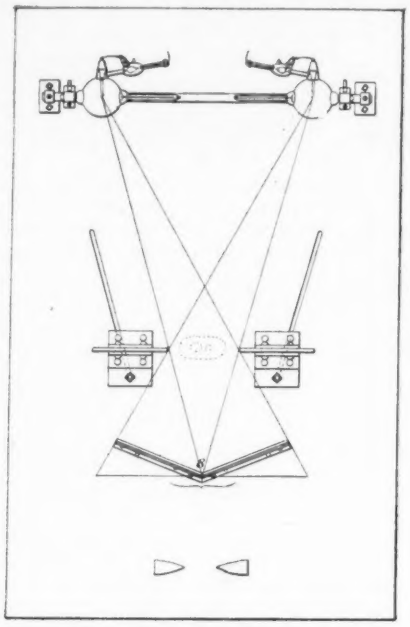
733,756. STEREOSCOPIC APPARATUS; Homer C. Snook, Philadelphia, Pa. App. filed Dec. 4, 1902. Consists in arranging two sources of X-rays in such relation to the object to be viewed that the beams of radiation will cross each other at the point where the object is placed and will produce upon a fluoroscopic screen a pair of images side by side representing the object as viewed, respectively, by the right and left eye of the observer.

733,766. COMBINED PORTABLE ELECTRIC LAMP AND BATTERY; Malcolm Sutherland and Elias Marcuson, London, Eng. App. filed April 11, 1902. Details.

733,789. MAGNETO ELECTRIC SEMAPHORE SIGNALING; Leonidas G. Woolley, Kenton, Ohio. App. filed May 26, 1902. An electrically operated detent mechanism is so arranged that when an electrical generator is set in operation manually at the switch tower, a motor will actuate the semaphore from one position to the other.



733,610.—Rheostat.



733,756.—Stereoscopic Apparatus.

733,876. FIRE ARRESTER FOR ELECTRIC INCANDESCENT LIGHT WIRES; Oscar H. R. Schulze, Chicago, Ill. App. filed March 8, 1902. Two blocks of asbestos having grooved faces, are clamped upon the wire to prevent fire following up the insulation on the wire.

733,883. ELECTRICAL ANNUNCIATOR; John H. Taylor, Schenectady, N. Y. App. filed Jan. 14, 1903. A program clock provided with means for automatically operating circuit closers at predetermined times.

733,900. ELECTRIC BRAKE SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Feb. 19, 1900. An apparatus for braking by gradually clutching a dynamo-electric machine to the load and causing a current to flow through the machine in such a direction as to oppose the motion imparted by the load.

733,901. METHOD OF BRAKING MOVING LOADS; Frank E. Case, Schenectady, N. Y. App. filed Feb. 19, 1900. A companion to the preceding patent.

733,909. TELEGRAPH REPEATER; Francis W. Jones, New York, N. Y. App. filed April 17, 1903. A repeater consisting of two main circuits, two relays, one in each circuit, a local circuit for each relay, three separate and distinct magnets in each local circuit, the first magnet operating to hold its relay arm when circuit in said relay coil is broken, the second magnet operating a spring contact point in the second main circuit, and the third magnet operating a circuit breaker in a shunt circuit around the holding coil of the other relay.